HOUSING POLICY

A thesis
submitted in partial fulfilment
of the requirements for the degree
of
Doctor of Philosophy
in the
University of Canterbury
by
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University of Canterbury

1982

ACKNOWLEDGEMENTS

In writing this thesis I have benefited from the willing assistance of my supervisor, Professor Richard Manning. Since 1977, when I was an undergraduate student of his at the University of New South Wales, Professor Manning's knowledge of, and enthusiasm for, the study of economics has been my constant inspiration.

I am indebted to a number of other people: My brother, Mr. Bruce Henry, of the School of Physics, University of New South Wales, and Dr. Don McNickle, of the Department of Economics, University of Canterbury, are thanked for computing assistance. All other members of the Department of Economics, University of Canterbury, have contributed something to my understanding of economics during the past two years, and so deserve thanks also.

I should also thank my typists, Mrs. Suzanne Troup, who typed an appendix, and especially Mrs. Karilyn Smith, who typed the remainder of the manuscript expeditiously and with considerable skill.

Finally, I owe an immeasurable debt of gratitude to my wife, Naomi, and to my children, Julia and Sebastien, for their considerable sacrifice while I was working on this thesis.

CONTENTS

ABSTRACT

In a number of Western countries, imputed rental income on owner-occupied housing is not taxed. In some countries, tax treatment is even more favourable, with mortgage interest payments and/or local property taxes being deductible against the owner-occupier's other income. These policies provide a tax subsidy to owner-occupied housing. The subsidy creates economic distortions; in particular, it encourages an inefficient allocation of productive resources, producing economic waste. In addition, it places an excess tax burden on capital employed in other activity, and on labour.

The distortions created by the favourable tax treatment of owner-occupied housing suggest issues of theoretical and empirical interest. A generalized user cost of capital methodology permits straight-forward investigation of the subsidy to owner-occupied housing in several Western countries. The distortions created by the subsidy are revealed by the development of, and empirical application of, a static three-sector general equilibrium model of tax incidence. The three sectors are owner-occupied housing, rented housing, and other industry. The economic distortions are of different degrees in different countries, but are invariably quantitatively significant.

Western governments are apparently persuaded by the dubious social arguments for owner-occupied housing. They are unlikely to be attracted by the "first-best" tax

policy which advocates an equal tax on capital in all uses. The three-sector general equilibrium model permits the derivation of second-best tax rates, which minimize ecomomic waste subject to the requirement that owner-occupied housing be subsidized relative to rented housing.

The favourable tax treatment of owner-occupied housing has important dynamic implications. Removal of the subsidy would stimulate intermediate-run growth, associated with improvements in resource allocation. In the context of long-run balanced growth it is possible to identify the (undiscounted) long-run utility maximizing subsidy to housing. These dynamic issues warrant further research.

CHAPTER ONE

INTRODUCTION

Housing is a consumer durable. The housing stock generates a flow of housing services, which are consumed directly. The occupier is the consumer of housing services. There are two types of occupiers, tenants and owner-occupiers. In the first case, ownership of the housing stock is vested in a non-occupying landlord. In the second case, ownership of the housing stock is vested in the occupier. Even in the second case it is convenient, and realistic, to conceive of the economic activities of owners and occupiers as being quite distinct, permitting separate analysis of each. Accordingly, the owner-occupier may be thought of as both landlord (owner) and tenant (occupier); being motivated by quite different incentives according to the role he is playing. For the most part, the economic activities of the occupier can be characterised in terms of a consumption motive. Likewise, the economic activities of the owner can be characterised in terms of an investment motive. An owner-occupier is both consumer and investor. Thus, the owner-occupier might have invested his equity in non-residential assets and paid rent to a landlord for tenanted accommodation, but instead, has perceived that he can obtain a higher return on his equity by investing in owner-occupied housing, and foregoing actual rental payments. As an investor, the owner-occupier is concerned with the provision of housing services for his own enjoyment, as consumer.

In the housing market, the price paid by the occupier for the consumption of housing services is the market return on the housing stock of the owner. As in any investment activity, the market return on the asset must cover the "user costs" (of depreciation, repairs and maintenance, casualty insurance premiums, interest payments on debt, the opportunity cost of equity, and taxes[1.]) of providing the housing services offered for consumption. This must be so whether the investor is a landlord or an owner-occupier.

The notion of the user cost of housing provides a convenient instrument with which to analyse the implications of housing policy.[2.] This instrument is exploited in this thesis.

Interest in the economics of housing, and housing policy, is easily justified: Reference need only be made to the quantitative significance of housing expenditures and housing incomes (respectively, corresponding to the consumption, and investment, aspects of the housing market) in the national accounts. Further, in terms of market value, the housing stock represents the most important set of reproducible durable goods in the national wealth of nearly all Western countries. This quantitative significance of housing is explored in Section 1.1.

Despite the quantitative significance of housing, economic analyses of housing policy have a comparatively short history; and while there has been quite a large amount of research in the U.S.A., and to a lesser extent, the United Kingdom, there has been very little analysis of housing policy in other countries. The first economic analysis of housing policy seems to be contained in Haig's (1921) seminal contribution to public finance. Haig was concerned with the distortions created by the failure to tax imputed rentals[3.] on owner-occupied housing under United States federal tax law. The comments made there were reinforced by the arguments of Simons (1938), (1950), and Vickrey (1947). Goode (1960) is the first comprehensive analysis of this issue, however. These analyses are reviewed in Sections 1.2 and 1.4. Since 1960 there has developed an enormous literature on housing and housing policy, particularly in the United States of America. Even so, there are a large number of areas deserving further research. These areas are exposed in Sections 1.2 to 1.6 of this Chapter.

As in many areas of economics, an historical examination of the various analyses of housing policy reveals a "vertical" progression through analytical techniques of increasing power and complexity. It is remarkable, however, that the literature is dominated by partial equilibrium analyses. It is argued in Section 1.4 that partial equilibrium techniques are not well-suited to an analysis of housing policy. This thesis has four main objectives: The first is to bring together the disparate partial analyses of housing policy by emphasising the investment motive in the demand for housing. The second is to employ the investment motive in the development of a general equilibrium model for the effective analysis of housing policy. The third is to extend the analysis to a consideration of the dynamic implications of housing policy. And the fourth is to explore the importance of housing policies in economies other than the U.S.A. and the United Kingdom; specifically, in Australia, Canada, and New Zealand.

This Chapter is structured as follows: Section 1.1 explores the quantitative significance of housing. Section 1.2 examines the range of housing policies, and the issues which arise in connection with those policies. Section 1.3 produces some data to illustrate the quantitative significance of housing policy measures. Section 1.4 examines the partial equilibrium analyses of housing policy, and explores their deficiencies. Section 1.5 emphasises the need for a general equilibrium approach to the analysis of housing policy, and suggests how this approach might be developed. Section 1.6 examines the dynamic implications of housing policy. Section 1.7 briefly reviews the "social" arguments in housing policy. And Section 1.8 presents a plan of the work in this thesis.

1.1 THE IMPORTANCE OF HOUSING

Investments in housing are a large proportion of total capital outlays in all Western countries. Table 1-1-1 presents estimates of gross fixed capital expenditure

TABLE 1-1-1: Percentage Distribution of Gross Capital Outlays by Form of Reproducible Tangible Capital; Various Western Countries; Current Prices.

Country	Year	Asset-Type			
		Residential Structures (1)	Non-Residential Structures (2)	Equipment (3)	Total (1)+(2)+(3)
Australia	1978	20.19	36.17	43.64	100.00
Belgium	1978	34.51	35.00	30.49	100.00
Canada	1978	25.74	40.02	34.24	100.00
France	1977	30.47	28.51	41.02	100.00
W. Germany	1978	27.59	31.66	40.75	100.00
Japan	1978	28.63	44.37	27.00	100.00
Luxembourg	1977	24.32	41.50	34.18	100.00
Netherlands	1978	28.00	33.04	38.96	100.00
New Zealand	1978	22.64	39.06	38.30	100.00
Norway	1978	16.47	48.19	35.35	100.00
U.K.	1978	17.93	31.14	50.93	100.00
U.S.A.	1978	27.59	31.88	40.53	100.00

Source: United Nations, Yearbook of National Accounts Statistics, 1979.

Notes:

1. Investment expenditure on Non-Residential Structures includes spending on other building and construction, including spending on land improvements, and plantation and orchard development.

2. All estimates are for the financial year ending in the period listed.

by major asset types as a percentage of total investment spending on tangible reproducible assets (excluding inventories). Estimates are for Australia, Belgium, Canada, France, West Germany, Japan, Luxembourg, Netherlands, New Zealand, Norway, the United Kingdom and the United States of America. Data are for 1978, except where indicated for 1977. Investment in dwellings varies between 16.47 and 34.51 percent of total investment spending on tangible reproducible assets, depending upon the country.

Housing stock figures are also of interest. Table 1-1-2 presents estimates of the value of national wealth by major asset type as a percentage of total reproducible tangible assets. The derivation of these estimates is described fully in Appendix A-1-1. Data are for all the countries listed above, except New Zealand. The necessary data are not available for this country. The estimates presented in Table 1-1-2 are remarkable. The percentage of total reproducible tangible assets made up of dwellings varies between 21.8 percent (for Norway) and 39.9 percent (for Belgium). In Belgium, France, and West Germany, the estimated replacement value of dwellings is larger than for any other asset-type. The differences in asset distribution among countries are largely explicable in terms of two economic phenomena. The first is that different countries exhibit different patterns of tax-subsidy policies designed to encourage investment in some assets (at the expense of others). One such policy is the exemption of

TABLE 1-1-2: Percentage Distribution of Net Tangible Reproducible Capital Stocks by Asset Type; Various Western Countries; Current Replacement Cost.

Country	Year +	Asset-Type				
		Residential Structures	Non-residential Structures	Equipment	Inventories	Total
Australia	1978	23.6	40.6	23.9	11.9	100.0
Belgium	1978	39.9	35.8	17.6	6.7	100.0
Canada	1978	29.2	41.2	20.0	9.6	100.0
France	1977	32.4	29.8	24.4	13.4	100.0
West Germany	1978	34.1	33.0	23.6	9.3	100.0
Japan	1978	26.4	40.5	24.1	9.0	100.0
Luxembourg	1977	32.2	42.3	18.1	7.4	100.0
Netherlands	1978	26.6	29.5	17.8	26.1	100.0
Norway	1978	21.8	46.0	28.8	6.4	100.0
U.K.	1978	25.7	34.7	25.8	13.8	100.0
U.S.A.	1978	32.2	35.3	22.5	10.0	100.0

\+ Estimates for Australia are as at 30th June, 1978. Estimates for all other countries are as at 31st December of the year indicated.

Source: Data in the table are derived from the capital stock estimates developed in Appendix A-1-1.

imputed rentals on owner-occupied housing from taxation, pursued by governments in many Western countries. Favourable tax treatment of income earned on any asset lowers the effective user cost of that asset, relative to the user costs of other assets. It is well-known that the price elasticity of demand for housing exceeds unity (Reid (1962), Muth (1960), Laidler (1969), Lee (1964), for instance). Tax policies which reduce the price of housing can have quite substantial impacts on the demand for housing. These issues are examined in more detail in Section 1.4. The second phenomenon is that different countries have different aggregate income levels, and this implies differences in the demands for particular assets. Since the income-elasticity of demand for housing also exceeds unity,[4.] then, ceteris peribus, countries with higher incomes can be expected to devote more of their resources to the provision of housing.

The explanation of differences in asset distributions among countries is complicated by the fact that the phenomena identified above are, to some extent, in conflict. Much of this thesis (Chapters 3 and 4, in particular) is concerned with this problem precisely. It might be noted here that tax-subsidy policies which distort the allocation of capital (like the subsidy on owner-occupied housing) imply real income losses for the economy as a whole. It is not so surprising, then, that countries like Belgium, West Germany, Luxembourg, and the Netherlands, which tax imputed rentals on owner-occupied housing, still devote large proportions of their total capital stocks to housing. Indeed, of the countries in Table 1-1-2, Belgium, West Germany, and Luxembourg have the highest per capita incomes; in each of these countries, imputed rentals on owner-occupied housing are taxed; and yet these countries rank 1, 2, and 4, respectively, in terms of the proportion of capital devoted to housing. It is possible that the real income effects, due to less distortionary tax-subsidy systems, dominate the price effects, due to the taxation of owner-occupied housing. To the extent that this is true, government policies designed to encourage home ownership are actually reducing the importance of housing in the total capital stock.

1.2 ISSUES IN HOUSING POLICY

There are an enormous number of government policies which have implications for the housing market. The attitude of Western Governments to the housing market, and the way in which this attitude becomes policy, is exemplified in the following passage from the United States Budget, 1981:

> "Federal housing policy continues to focus on the basic goal of providing a decent home in a suitable living environment for every American family. Federal housing programs carry out this goal by:
>
> - Ensuring an adequate supply of mortgage credit;

- Increasing the stock of housing through new construction and rehabilitation programs; and
- Providing explicit subsidies primarily for low-and-moderate-income households."[5]

The particular policies embodied in the Federal housing programs of the United States Government have been adopted by nearly all Western Governments. While the degree of government activity differs among countries, in most Western countries government policy involves a mixture of:

(1) The provision of State and Local Authority housing;

(2) the supply of mortgage finance, usually at subsidised interest rates;

(3) loan guarantees;

(4) a number of tax incentive schemes for owner-occupied housing;

(5) rent controls;

(6) security of tenure provisions for protected classes of tenants;

(7) urban renewal and rehabilitation programs;

(8) the provision of finance for home improvement projects at subsidised interest rates;

(9) the specification of building and housing codes;

(10) licensing of builders and contract workers;

(11) legislation to specify and to protect property rights;

(12) regulation of conveyancing and land transfer;

(13) zoning regulations.

No other market can boast such a high degree of government interference as exists in the housing market. Clearly, housing is a very important asset.

Economic analyses of housing policy are concerned with two broad issues: The first is whether the policy has worked. i.e., whether the policy has achieved its stated objective(s). The second is, if the policy can achieve (or has achieved) its objectives, whether there is a better policy for achieving those objectives. Every one of the thirteen housing policies listed above could be subjected to these sorts of analyses, and every policy might be deemed inappropriate on the basis of some economic criterion. This thesis is not an attempt to do that. Instead, this thesis confines itself to an analysis of just one class of housing policies; specifically, those policies which are concerned with the taxation of housing and of housing incomes. This is the class of housing policies commented on by Haig, Simons, and Vickrey and analysed by Goode (1960). The issues raised by those writers (i.e., those pertaining to the exemption of imputed rentals on owner-occupied housing from taxation) have subsequently been analysed by Muth (1960), Laidler (1969), Aaron (1970), (1972), Ott and Ott (1973), White and White (1977), Rosen (1979), Rosen and Rosen (1980), and others, employing a variety of theoretical and empirical techniques. There is an enormous literature which examines the incidence and efficiency aspects of property taxes and local government spending on the housing market: Aaron (1975), Grierson (1974), Hamilton (1976), Hyman and Pasour (1973), A.T. King (1973), (1977), Netzer (1966), Simon (1943), Wales and Wiens (1974), Rosen and Fullerton (1977), Orr (1968), Oates (1969), (1973), Church (1974), Meadows (1976), Bickerdike (1902), Dusansky et al (1979), for instance. Other issues in housing policy analysed by economists include: The optimal supply of housing capital (Reid (1958), Winnick (1956), Dusansky and Kalman (1979)); and the economic effects of rent controls (Lindbeck (1967), Gelting (1967)).

Before identifying the issues which arise in connection with the taxation of housing and housing incomes, it would seem appropriate to define the concept of housing income. The most widely accepted economic interpretation of income is the Haig-Simons-Hicks[6.] definition of this concept as being "... the algebraic sum of (1) the market value of rights exercised in consumption and (2) the change in the value of the store of property rights between the beginning and end of the period in question"[7.]; or "... the money value of the net accretion to one's economic power between two points of time"[8.]; or "... the maximum value which [the income-earner] can consume during a week, and still expect to be as well off at the end of the week as he was at the beginning."[9.]

For the landlord, housing income might be calculated by subtracting from gross rent the sum of depreciation, repairs and maintenance expenses, casualty insurance premiums, mortgage interest payments, and taxes, and adding to this the value of accrued capital gains on the house during the period. For the owner-occupier it might be simpler to first calculate the value of his housing consumption during the period, subtracting from this the sum of the costs incurred as a home-owner (i.e., depreciation, repairs and maintenance, etc.), and then adding accrued capital gains. The market value of housing consumption is the gross rental payments that the house would earn (or does earn) if let in the private rental market. Accordingly, whether the house is tenant-occupied (i.e., owned by a landlord) or owner-occupied, the housing income of the asset-owner is the net rental value of his asset, plus the accretion in value of that asset over the period in question. The only difference between the housing income in each case is that in the case of a house owned by a landlord the income is calculated on the basis of actual gross rental receipts, whereas in the case of owner-occupied housing the income must be calculated on the basis of the imputed value of housing services consumed by the owner-occupier, as occupier. It is for this reason that the income on owner-occupied housing is referred to as an "imputed" income.

The third component of housing income is mortgage interest payments. While these payments are an expense from the point of view of the mortgagor (landlord or owner-occupier), they represent an income to the mortgagee.

Net rental payments and accrued capital gains are the return to equity capital; mortgage interest payments are the return to debt capital.

According to tax legislation in all Western countries, the net income of landlords is taxable; though in most countries accrued capital gains are not. The return to debt capital is also taxable. But in many Western countries (including Australia, Canada, New Zealand, the United Kingdom, and the United States of America) the imputed return to equity invested in owner-occupied housing is not taxed.[10.]

There are four important issues which arise in connection with the failure to tax imputed rentals on owner-occupied housing. The first relates to the concept of vertical equity, the idea that tax liability as a proportion of income should exhibit the "right" degree of progressivity (whereby higher income earners face higher average tax rates). Section 1.4 illustrates that the failure to tax imputed rentals reduces the progressivity of the income tax. The second issue relates to the concept of horizontal equity, the idea that individuals of similar economic circumstance should face similar average rates of income tax. Here, it is argued that the failure to tax imputed rentals discriminates against renters relative to owner-occupiers. The third relates to the efficiency of the tax. The idea here is that the favourable tax treatment of owner-occupied housing distorts the allocation of productive assets among uses; inducing a flow of assets from high-yield uses to a use with a relatively low rate of return, reducing aggregate levels of welfare. The fourth relates to the incidence of the tax. i.e., what are the implications of the subsidy for private and social rates of return on owner-occupied and rented housing, for the net rates of return on other assets, on other factors, and for output prices.

Central to the questions of efficiency and incidence is the distinction between social and private rates of return. The social rate of return pretends to measure the market value of productive services utilized in the period, after deductions for depreciation and depletion.[11.] The social return differs from the private return by including taxes as part of income. Taxes levied on housing income can be thought of as the housing income of government. This is the fourth component of housing income. It is clear that those sectors in the economy which face the smallest tax rates will also have the smallest separation of social, from private, rates of return.

Simons' arguments against the exemption of imputed income from taxation in the United States are as pertinent now as they were in 1938. Then, he argued that "... [w]hen property is employed directly in consumption uses, there is the strongest case for recognising an addition to taxable income. This is widely recognised in criticisms of our federal tax for its egregious discrimination between renters and homeowners",[12.] and: "Income from consumers' capital is often a large part of total income for individuals in the upper brackets. To exclude it is to introduce a bias inconsistent with the system of progression and to differentiate flagrantly among persons of really similar financial circumstances".[13.] These arguments pertain to the criteria of horizontal and vertical equity described above.

Despite the arguments of Simons, and many who came after him, imputed rentals have never been taxed in the United States of America, Canada, or New Zealand. But the same is not true for some other countries. In particular, the United Kingdom income tax base once included imputed rentals on owner-occupied housing. The tax was removed in 1963, after more than 100 years' operation. The mechanics of the tax in the United Kingdom, and its history, are of interest because of the arguments often heard in the United States, and elsewhere, that the tax would be impossible to administer.[14.] In the United Kingdom, the tax was levied on the estimated annual value of land (including houses and other buildings), whether the property was let at full rent, at less than full rent, or was owner-occupied. The estimated annual value was revalued periodically. It purported to reflect the full rent the property commanded, or could command, if let. There were "normal" deductions for repairs and maintenance. Interestingly, the tax was charged to the occupier, whether owner or tenant. If the occupier was a tenant, he was entitled to deduct the tax payment from his periodic rent payments, thus sharing the burden of the tax with the landlord. Where the actual rent was less than the estimated net annual value (i.e., annual value less "normal" deductions) the occupier bore the whole of the tax on the difference - referred to as his "beneficial occupation". The owner-occupier, with no actual rent to pay, bore a tax on the whole of the net annual value of his property.

The Radcliffe Committee in the United Kingdom[15]. received a number of representations which argued that the tax on the owner-occupier should be abolished. The principal arguments advanced were that:

(1) it is wrong in principle to tax notional (imputed), as distinct from actual, income; and

(2) it is inequitable to single out the notional income from owner-occupied housing when the notional income which might be imputed to other consumer durables is not taxed.

The Committee dismissed these arguments, concluding that the tax on the owner-occupier was right in principle and ought to be maintained. Never-the-less, the question of abolition became a regular subject of debate on the Finance Bill. When it was finally abolished in 1963 all parties in Parliament accepted that the abolition would introduce a discrimination in tax treatment in favour of a particular class of tax payer, but the Government was impressed by the social arguments for exemption. The overriding consideration was the encouragement of the owner-occupation of housing.

The Irish Republic followed the United Kingdom in abolishing the tax on owner-occupied housing in 1969. France has since abolished the tax as well. But Germany, the Netherlands, Belgium, Luxembourg, Italy, and Denmark, all retain the tax. Japan, too, has a tax of this sort.

The favourable tax treatment of owner-occupied housing in many Western countries arises primarily because of the failure to tax imputed rentals. But in some countries the extent of the subsidy to owner-occupied housing is even larger than what is implied by this exemption. In the United States, for instance, owner-occupiers are permitted to deduct mortgage interest payments and local property taxes against other income in assessing taxable income. Tax policies of this sort are considered in some detail in Chapter 2. Section 1.3 of this Chapter presents some estimates of the size of the "tax expenditures"[16.] implied by the United States tax treatment of owner-occupied housing. The issues which arise in connection with housing policy have both static and dynamic implications. Sections 1.4 and 1.5 are concerned with the static implications of these issues, while Section 1.6 examines the dynamic aspects.

1.3 QUANTITATIVE ASPECTS OF HOUSING POLICY.

One of the objectives of this thesis is to quantify the various issues which arise in connection with the tax treatment of housing. In this Section we present official estimates of the size of the "tax expenditures" on housing in the United States, and present estimates of the size of some of the direct forms of government interference in the housing market in other countries. The motivation for this exercise is simply to illustrate that government programs in the housing market are quantitatively significant. In the United States, the Congressional Budget Act requires that all "tax expenditures" be officially estimated and presented each year in the Budget. Table 1-3-1 presents some estimates prepared by the United States office of Management and Budget for the years 1979, 1980, 1981. Separate data for tax expenditures on owner-occupied houses and the corporate investment tax credit, only, are presented. The Table also presents these tax expenditures as a percentage of total budget receipts in the appropriate fiscal year. Estimates of the tax revenue losses due to the deductibility of mortgage interest payments on owner-occupied housing against other income are almost as large as the revenue loss due to the corporate investment tax credit, which has assumed such importance in the literature on investment tax incentives (see Hall and Jorgenson (1971), and Coen (1971), for instance). Tax expenditures due to the deductibility of property taxes are about half the size of the corporate investment tax credit. These figures are quite large, even as a percentage of total tax receipts. Because owner-occupied housing has never been taxed in the United States, this policy is not considered a tax expenditure in that country. For this reason, the loss of tax

TABLE 1-3-1: Tax Expenditures Due to Federal Tax Laws, United States, 1979, 1980, 1981.

Tax Item	Tax Expenditure					
	1979		1980		1981	
	$ Million	% of Tax Receipts	$ Million	% of Tax Receipts	$ Million	% of Tax Receipts
Corporate Investment Tax Credit	13965	3.0	15825	3.0	17000	2.8
Deductibility of Mortgage Interest on Owner-occupied Housing	10745	2.3	12505	2.4	14760	2.5
Deductibility of Property Taxes on Owner-occupied Housing	6760	1.5	7740	1.5	8975	1.5

Source: U.S. Office of Management and Budget, United States Budget, 1981. Special Analysis G. Estimates are developed by the Treasury Department, and are based on tax law enacted as of December 31, 1979.

revenue due to this policy is not estimated by the United States office of Management and Budget. Of course, if imputed rentals or owner-occupied housing were to be taxed, the revenue losses presently due to the deductibility of mortgage interest payments and property taxes would no longer be considered tax expenditures, since it would be "normal" practice to allow these as deductions from housing income. Estimates of the subsidy to owner-occupied housing developed in Chapter 4 of this thesis indicate that the revenue loss due to the exemption from taxation of the net income earned by owner-occupied housing is approximately twice as large as the sum of the tax expenditures presented in Table 1-3-1.

Willis and Hardwick (1978) estimate that if the tax on owner-occupied housing were re-introduced in the United Kingdom, and if rateable values current in 1974-75 were adopted as the measure of imputed income, the additional tax yield in that year would have been about £930m., approximately 10 percent of income tax revenue actually received.

In some cases, data on the magnitude of direct government activity in housing are easier to find. In Australia, a survey of housing occupancy conducted by the Australian Bureau of Statistics in August 1980[17]. revealed that an estimated 4,771,100 households occupied private dwellings (i.e., dwellings other than hotels, motels, and the like). Of these, 1,190,700 occupied rented accommodation; and of the renters, 227,700 (19.1

percent) made rental payments to government landlords (generally a State Housing Department, or Commission). In addition, the average weekly rent for government tenants was only 55 percent as large as that paid by private tenants.[18.] In Australia, much residential investment, too, is done by government authorities. Table 1-3-2 presents estimates of the percentage distribution of gross capital outlays by public and private sectors in Australia in the 1977-78 financial year. 4.3 percent of all public capital outlays were for dwellings. 29.7 percent of all private capital outlays were for the same asset.

Other countries exhibit similar pictures of direct government activity in housing. Data presented in the (U.K.) Annual Abstract of Statistics, 1975 (Central Statistical Office) indicate that, on average, more than 35 percent of all dwellings in the United Kingdom were owned by public authorities over the period 1964-74. The Statistical Abstract of the United States, 1977[19.] reveals that in 1975, 4.32 percent of total government (federal, state, and local) capital outlay was for housing and urban renewal. This is much the same as for Australia. It is significantly more than U.S. government capital outlays on health and hospitals, space research, parks and recreation facilities, and water and air transport.

Government provision of mortgage credit is of very large magnitudes in many Western countries. In Canada, for instance, approximately one-third of all houses built

TABLE 1-3-2: Percentage Distribution of Gross Capital Outlays, Public and Private Sector, Australia, 1977-78.

Asset Type	Percentage of Grand Total	Percentage of Total Public	Percentage of Total Private
Private:	62.56		100.00
Dwellings	18.58		29.70
Other Building & Construction	10.87		17.38
All Other	33.11		52.92
Public:	37.44	100.00	
Dwellings	1.61	4.30	
Other Building & Construction	25.30	67.57	
All Other	10.53	28.13	

Source: Australian Bureau of Statistics, Australian National Accounts, National Income and Expenditure, 1977-78.

between 1935 and 1968 were financed by a government body under the Housing Acts.[20.] In the United States, 7.7 percent of all outstanding mortgage debt on private dwellings was held by government agencies in 1975.[21.]

1.4 PARTIAL EQUILIBRIUM ANALYSES:

Partial equilibrium models are employed in all economic analyses of housing policy. The partial equilibrium technique implies the analysis of equilibrium in one market, or one particular set of markets, without reference to the pattern of equilibrium in other markets. The application of this technique is logically valid, either when the markets being analysed are very small (relative to the rest of the economy), or separable, so that disturbances in these markets have no perceptible impact on the other markets. Section 1.1 demonstrates that the housing market does not satisfy the first of these criteria: In terms of the value of productive resources devoted to that sector, the housing market is one of the largest markets in the economy. The second criteria is not satisfied either: For example, the income elasticity of demand for housing is quite large (approximately 1.5). Goode (1960) emphasises the discriminatory implications of the United States taxation provisions for horizontal equity as between renters and owner-occupiers, and estimates the revenue loss due to those provisions. Goode estimates that in 1958 United States federal income tax revenue would have been approximately $3.2 billion greater than its actual level of $59.1 billion; $1.2 billion of this being due to the taxation of imputed net rent (gross rent minus interest on mortgage debt, property taxes, depreciation, repairs and maintenance, and casualty insurance premiums), and the other $2.0 billion from eliminating the personal deductions for mortgage interest and property taxes on owner-occupied dwellings. This total tax saving represents 12.6 percent of the gross imputed rent of owner-occupied dwellings, and 8.7 percent of the gross rent of all dwellings.

Rosen (1979a), (1979b), and Rosen and Rosen (1980) use econometric techniques to estimate the impact of the United States income tax provisions on the demand for housing. Rosen and Rosen (1980) calculate that about one-quarter of the increase in home ownership in the U.S. since 1945 can be attributed to the distortion of tax liability in favour of owner-occupied housing. King and Atkinson (1980) explore the implications of U.K. tax legislation for the differential costs of housing by tenure group; in particular, their analysis differs from other similar analyses by comparing the costs of owner-occupiers with rentals paid by public authority tenants (these are the two largest tenure groups in the United Kingdom), rather than with the situation of private tenants. They find that while the rate of return on public authority housing is approximately one-half of the rates of return in commercial and industrial sectors, the average costs of owner-occupiers are even lower than public authority rentals. King (1981) analyses the implications of the tax treatment of housing for tenure choice.

The impact of taxation policies on tenure-choice relates to the extent to which those policies discriminate between owner-occupiers and tenants. Aaron (1970) presents an illustration of the horizontal inequity as between owner-occupiers and tenants due to United States tax law: We compare tax liability of two individuals. Each individual has the same labour income ($10,000), and receives the same amount of investment income ($1,000). One individual is a renter, and the other, an owner-occupier. In the case of the renter, the whole of the $1,000 investment income is derived from non-residential assets; in the case of the owner-occupier, however, $600 is derived from non-residential assets, while the other $400 is derived from equity invested in owner-occupied housing. Each individual pays the same gross rental price for housing. The tax liabilities of the renter and owner-occupier are illustrated in Table 1-4-1. If tax laws treated income from all sources alike, the renter and owner-occupier would have the same tax liability, and would have the same disposable income. Under 1970 tax law, the differences in tax liabilities and disposable incomes are quite large.

In addition to the issue of horizontal equity, much of the literature, in the United Kingdom and the United States, has emphasised the implications of housing

TABLE 1-4-1: Tax Treatment of Renters and Owner-Occupiers under 1970 United States Tax Law; An Illustration.

	Renter ($)	Owner ($)
Labour Earnings	10,000	10,000
Investment Income at 4%		
(i) On non-residential assets		
(a) $25,000 at 4%:	1,000	
(b) $15,000 at 4%:		600
(ii) On equity in home		
(a) $10,000 at 4%:		400
Money Income	11,000	10,600
Rent Payments	2,500	
Housing Expenses		2,100*
Residual Money Income	8,500	8,500
Tax Liability+	1,304	962

Source: Adapted from Aaron (1970)

* 2100 + 400 = 2,500.

\+ Assumptions: a) Housing costs are 25% of earnings for both renter and owner-occupier. Mortgage interest is $900 (6% of $15,000 mortgage); property taxes are $500.

b) Renter and owner-occupier have 4-person households.

c) Renter claims standard deduction.

d) Owner-occupier itemizes deductions: $1,400 in mortgage interest and property taxes; $1,000 in other deductions.

taxation policies for vertical equity in the individual income tax. Thus, Goode (1960), Aaron (1970), (1972), and King and Atkinson (1980) all consider the size of the subsidy to owner-occupied housing in different income groups. As might be expected, the favourable tax treatment of owner-occupied housing is usually found to reduce the progressivity of the income tax. There are two main reasons for this: Firstly, since the income-elasticity of demand for housing exceeds unit (or, put another way, the marginal propensity to consume housing exceeds the average propensity to consume) higher income earners derive a larger share of their income from untaxed (imputed) rentals on housing than lower income earners. And, secondly, the subsidy to owner-occupied housing varies proportionately with the individual's marginal tax rate; so that individuals on higher incomes, facing higher marginal tax rates, derive larger subsidies on housing than individuals on lower incomes. These two reasons are illustrated in Table 1-4-2.

The illustrations in Table 1-4-2 use a very simple tax-scale: The first \$10,000 of assessed income is taxed at a rate of 20 percent; all assessed income above \$10,000 is taxed at a rate of 30 percent. One individual earns \$9,000 labour income, the other \$10,000. The individual earning \$9,000 receives \$1,000 in imputed net rent on owner-occupied housing. If the income-elasticity of demand for housing is 1.5, then the individual earning \$10,000

TABLE 1-4-2: Tax Treatment of Owner-occupiers of Different Income Levels; An Illustration

	Individual 1($)	Individual 2($)
Labour Earnings	9,000	10,000
Net Housing Income:		
(i) η_H^M = 1,5*	1,000	$1,166.\dot{6}$
(ii) η_H^M = 0	1,000	1,000
Present Tax Liability:+	1,800	2,000
Average Tax Rate on Labour Earnings:	.20	.20
Average Tax Rate on Total Income:		
(i) η_H^M = 1.5	.18	.179
(ii) η_H^M = 0	.18	.182
Tax Liability when all Income is Taxed		
(i) η_H^M = 1.5	2,000	2,350
(ii) η_H^M = 0	2,000	2,300
Average Tax Rate on Total Income:		
(i) η_H^M = 1.5	.20	.210
(ii) η_H^M = 0	.20	.209

+ The tax-scale is: $(0-10,000): .20
$(10,000→) : .30.

There is no mortgage interest or property tax deductibility.

* η_H^M is the income-elasticity of demand for housing.

receives $1,166.67 in imputed net rent on owner-occupied housing. If all income (labour earnings plus imputed net rent) were taxed, the income-elasticity of demand for housing would have a small impact on average tax rates: Whether the income-elasticity is 1.5 or 0 the average tax rate is .20 for the first individual, and varies from .210 to .209 for the second. The interesting result is that if rentals on owner-occupied housing are not taxed, and if the income-elasticity of demand for housing is 1.5, then the individual on the higher income faces the lower average tax rate; the income tax is regressive in this illustration. The second result of interest is that the differences between average tax rates are smaller when imputed rentals are not taxed; and this is independent of the income-elasticity of demand.

The implications of housing policy for horizontal and vertical equity are examined in some detail in Chapter 2 of this thesis.

A number of partial equilibrium analyses of housing policy have concentrated on the efficiency aspects of the tax subsidy to owner-occupied housing. Aaron (1972) and Laidler (1969) assume that the supply of housing is perfectly elastic; put another way, that the net rate of return on housing capital is determined outside of the housing market, and is constant. The effect of the subsidy on owner-occupied housing is to cause a flow of benefits from the government to owner-occupiers, without any effect on housing stock prices or rental prices.

Laidler estimates, on the basis of 1960 United States data, that there was over $60 billion invested in owner-occupied housing that would not have been invested there if the subsidy did not exist; and this was found to imply an annual (Marshallian) welfare loss of over $500 million. Laidler uses a price-elasticity of demand of -1.5 in his calculations. The Laidler (1969) analysis is examined in some detail in Chapter 4 of this thesis.

One of the nice features of the Laidler partial equilibrium analysis is its simplicity: There is only one market to worry about; all substitution effects between tenures are ignored. Using this sort of analysis it is possible to derive order-of-magnitude estimates of the efficiency effects of a large number of housing policies. One policy, of some recent interest, is the policy publicised in the 1981 New Zealand Budget Speech, which provides for a tax rebate of 50 percent of mortgage interest payments on owner-occupied houses, for the first five years of home ownership. The total value of the tax saving is not to exceed $1,000 for any one home owner. Estimates developed in Chapter 4 of this thesis reveal that in the financial year 1977-78, there were 1723.5 million units of capital employed in owner-occupied housing, where one unit is the quantity of capital needed to generate one dollar of net income. The effect of the new policy measure will be to reduce the user costs of owning a first home by

$$\frac{.5(r_m\phi)}{r_c} \text{ dollars per unit,}$$ [22].

<u>where</u>: r_m is the mortgage interest rate.

ϕ is the proportion of the house value that would be convered by mortgage debt.

r_c is the net rate of return, or opportunity cost, of investing equity in housing.

According to the estimates presented in Chapter 4, the user costs of owner-occupied housing were $0.90 per unit in 1977-78. If we assume that $r_m = r_c$, and that 70 percent of the finance for a first home is raised by mortgage finance, for the average first home purchaser, we have that the percentage change in the user cost of capital due to the policy announced in the 1981 Budget is approximately -38.89 percent. If the price-elasticity of demand for new housing is -1.5, then the demand for (new) housing will increase by 58.33 percent. The annual (Marshallian) deadweight loss associated with the policy in 1977-78 would have been:

$$\tfrac{1}{2} \times .3889 \times .5833 \times P^{*}_{K1}K_1 \qquad 23.$$

<u>where</u>: P^{*}_{K1} is the gross rental price on owner-occupied housing (equals user cost).

K_1 is the physical quantity of capital employed in owner-occupied housing.

The deadweight loss evaluates at $175.6 million per annum (approximately $60 per capita, per annum).

The Laidler (1969) analysis has been criticised for its lack of realism, of course. Some criticisms have been even more significant: M.J., and L.J. White (1977) attack the infinite supply elasticity assumption of Aaron (1970), (1972), and Laidler. They permit the supply schedule for housing to have any positive elasticity. In addition, it is supposed that there is complete supply substitutability of owner-occupied and rented housing. It is shown that Laidler's estimate of the deadweight welfare loss is biased upwards, and that the most important implications of the owner-occupier subsidy are of a distributional nature: For instance, if the elasticity of supply of housing is unitary, deadweight losses due to the subsidy are $680m. per annum (based on 1970 data. Compare with $1.04b. per annum, which would be Laidler's estimate on the same data), while the transfer of benefits from renters to landlords as a result of the subsidy is $1.74b. per annum.

The most remarkable feature of the White and White (1977) analysis is the implicit assumption that the demands for owner-occupied housing and rented housing are independent. i.e., the results of the White and White paper depend upon an absence of substitution between tenures. Hence, the estimates of the effects of the owner-occupier subsidy assume that if the subsidy were eliminated there would be no change in the number of renters (although each renter would consume more units of housing services as the rental price fell).[24.] In fact, the interdependence of renter and owner-occupier demands for housing is one of the most important descriptive features of the housing market; a feature which has been exploited analytically, and empirically, by King (1980), and Rosen and Rosen (1980).

The papers by Aaron, Laidler, and White and White are concerned with some of the same issues that are explored in this thesis, but they are all partial equilibrium analyses: Only Aaron (1972) offers some comment on the general equilibrium implications of the owner-occupier subsidy. The partial equilibrium technique suffers from the (usually implicit) restrictive assumptions which support it. An honest application of partial equilibrium tools precludes analysis of many of the interesting issues arising in connection with housing policy, and taxation policy in general. These issues are examined in the next Section.

1.5 GENERAL EQUILIBRIUM CONSIDERATIONS.

The efficiency costs of the favourable tax treatment of owner-occupied housing arise because of the distorted allocation of resources induced by that tax policy. In the Laidler (1969)-type partial equilibrium analyses of the efficiency issue, the effects of the distortions are explained in the following terms: The marginal unit of productive capital currently employed in owner-occupied housing would yield more utility if employed in the provision of other commodities. The additional amount of utility is equal to the unit subsidy on owner-occupied housing.

The total welfare cost of the subsidy is the sum of the utility losses on each of the units of housing that would not be employed in this sector if the subsidy were removed.

As was noted in Section 1.4, measurement of the welfare cost of the owner-occupier subsidy by partial equilibium techniques requires assuming an exogenous net rate of return on housing capital. Given the quantitative significance of housing, however, this assumption is remarkably unrealistic: Even a very small percentage increase in the quantity of capital employed in owner-occupied housing implies that a large quantity of capital is removed from other sectors in the economy, and this must have an impact on the net rate of return on capital.

Any measure of "overinvestment"[25.] in owner-occupied housing arising from the subsidy will be associated with a corresponding "underinvestment" in other sectors. The assumption usually made in studies of the incidence and efficiency effects of capital taxes is that private net rates of return are equalized among sectors both before and after a tax disturbance. To the extent that this is true, social rates of return on various assets will differ according to the tax differentials among sectors. A marginal reallocation of resources from a lightly taxed to a heavily taxed sector will increase social income (gross domestic product, for instance) because of this. Considerations of this sort can be analysed properly only with general equilibrium techniques.

In particular, it seems futile to attempt to measure the incidence of the subsidy on owner-occupied housing unless it is admitted that the subsidy will affect rates of return on all assets.

Despite its shortcomings, however, the importance of the partial equilibrium technique in public finance is indicated by the suggestion of McLure (1975) that prior to the publication of Harberger's seminal paper on the incidence of the corporation income tax (1962), the theory of tax incidence had not advanced much beyond what is contained in Marshall's Principles of Economics. Harberger's general equilibrium technique (1962), (1966), represents the most prominent contemporary approach to the analysis of tax incidence. The power of this approach lies in its ability to analyse the responses to a policy disturbance in product and factor markets simultaneously, as well as emphasising the relationships among individual markets for factors and products. The approach is able to describe the supply response in a particular product, or factor, market to changes in relative product, and/or factor, prices, incorporating the effects of interractions in markets for other products, and factors. In contrast, partial equilibrium analyses of tax incidence are unable to explicitly analyse a number of important issues, like the effects of tax disturbances on factor rewards in untaxed industries, or on those who purchase untaxed products. Thus, for instance, Laidler's (1969) study assumes a constant after-tax net rate of return on capital, so avoiding the incidence question completely.

The paper by Ott and Ott (1973) appears to be the only general equilibrium analysis which relates to the housing market. They divide the total United States capital stock among corporate, agricultural, and housing sectors (owner-occupied housing and rented housing are grouped together). Their conclusion is that most of the "underallocation" of capital to the corporate sector has benefited the housing sector. This result, which the authors find surprising, is in fact an implicit assumption made in all the partial equilibrium analyses of housing policy: Any difference between the rates of tax on housing and other capital is interpreted as a subsidy on housing, so encouraging "overinvestment" in housing. Given the other assumptions embodied in the Laidler (1969) and White and White (1977) papers, it says nothing much more than that the demand curve for housing is downward sloping. Never-the-less, it would be comforting to know that the assumptions are correct.

The disturbing feature of the Ott and Ott (1973) paper is its claim to be a three-sector general equilibrium analysis of tax incidence, when it is not; or, if it is, it assumes away most of the important issues which general equilibrium models are usually designed to analyse. In fact, the questions of the incidence of capital taxes on net factor prices, and on output prices, are brushed aside by the (implicit) assumption that all taxes on capital are not "shifted": i.e., an increase in the tax rate levied on capital income in one sector will increase the gross rental price of capital in that sector by the full amount of the unit tax increase, with no effect on the after-tax unit income. Hence, suppose that a unit tax of T_K is imposed on capital in all uses, and that there were no pre-existing distortions. Then, the gross rental price of capital would rise by T_K in all sectors. But since this tax policy is neutral,[26.] and since the total capital stock is assumed fixed, the allocation of capital among sectors must be the same after the tax as before. Under competition (where the demand curve for capital in each sector is its value marginal product schedule) this result can only emerge under the Ott and Ott assumptions if output prices (equal marginal costs) for all commodities i increase by T_K/MP_{Ki} (where MP_{Ki} is the marginal physical product of capital employed in sector i). In fact, as Harberger (1962) and many others have demonstrated, if the total capital stock is fixed, the imposition of a neutral tax on capital causes the after-tax unit net income to fall by the amount of the tax, with no affect on output prices. This is precisely the opposite set of results to those implied by the Ott and Ott (1973) assumption.

Consequently, despite the debt of gratitude Ott and Ott express to Harberger in the leading footnote of their paper, the model they employ is inconsistent with general equilibrium models of tax incidence; in particular, it bears no relationship to the Harberger (1962) model.[27.]

McLure (1975) suggests that the most significant new improvement on the Harberger (1962) model would be to extend the model to cover three sectors, rather than two. The reason offered is that this would permit the analysis of tax incidence when there is complementarity among sectors. But there is another reason: If the three-sector model had been available to Ott and Ott (1973) their paper might have represented a fundamental contribution to the tax incidence literature. In addition, the three-sector model could be used to analyse a host of interesting tax incidence questions which cannot be handled by the two-sector model. One such question is the general equilibrium implications of the favourable tax treatment given owner-occupied housing: A three-sector model would permit the examination of the misallocation of capital, not merely as between housing and "other industry", but as between housing tenures. Given the importance of the owner-occupied subsidy in the analysis of housing policy, particularly in that it favours owner-occupiers over renters, this would seem to be an important study.

Chapter 3 of this thesis develops the three-sector general equilibrium model of tax incidence. Chapter 4 applies the model to an examination of the general equilibrium implications of the favourable tax treatment of owner-occupied housing. We identify three sectors: Owner-occupied housing; rented housing; and "other industry". The model is applied to data for Australia, Canada, New Zealand, the United Kingdom, and the United States. In the United Kingdom case, the rented housing sector comprises local authority housing.

1.6 DYNAMIC CONSIDERATIONS

Harberger (1964b) argues that it "is likely that the feature which best distinguishes the economic thinking (both professional and popular) of the postwar period from earlier decades is the emphasis placed upon economic growth - as a phenomenon to be explained, as a criterion of economic performance, and as an objective of policy."[28.] Almost without exception, major analyses of the inefficiencies arising from the non-neutral taxation of income-producing assets emphasise that such inefficiencies are inimical to growth. While Musgrave (1963) can justify his interest in the impact of United States tax policy on private capital formation by the implications of aggregate levels of investment for the rate of growth of output, what is just as important is the effects of tax policy on the composition of investment. Thus, it is often argued, any government policy which implies non-neutral taxation of capital can be expected to have adverse implications for economic growth.

The investigation of the implications of housing taxation policies for rates of economic growth has, previously, received little better than passing reference. A remarkable example is provided by Denison (1967, p.156):

> "It is likely that every country considered would have obtained a higher growth rate of measured national income (though not necessarily of economic welfare) by diverting investment from housing to nonresidential business investment

> if it could have done so. In Europe this generally was politically impossible, while in the United States the demand for nonresidential investment was insufficient in much of the period to have taken up any slack that would have been created by reducing residential construction."

The way in which a reallocation of investment from residential to nonresidential uses increases the rate of growth is quite simple: Because housing is taxed favourably, relative to capital employed in other sectors, the social rate of return on housing capital is less than that on other capital. Hence, a reallocation of the share of total investment going to each sector, from residential to nonresidential uses, increases the measured rate of growth of national (social) income. Denison's reasons for avoiding an explicit analysis of the impact of housing on growth are, however, unacceptable. What is and what is not an "acceptable" allocation of resources depends upon the set of prices facing consumers and producers. These prices are, to an extent, both the reasons for, and the results of, government activity. If it can be demonstrated that an alternative set of prices produces a superior outcome, some of the reasons for political support of existing policies are removed. The second argument, that there is an "insufficient demand" for nonresidential capital is even less acceptable. The demand for nonresidential capital depends upon the price of nonresidential capital (and on other prices). As Chapter 4 illustrates, the removal of the present non-neutral tax provisions would reduce the price of nonresidential capital, and increase the price of residential capital, with a consequent flow of capital from housing to nonresidential business.

Given the interest in economic growth, and the suggestion of Denison, and others, that the rate of economic growth is dependent upon the allocation of investment among residential and nonresidential uses, it is surprising that there has been no attempt to explore the statistical relationship between growth rates of output and the distribution of capital among housing and other sectors. A brief statistical investigation of this relationship is presented here. Table 1-6-1 presents estimates of the percentages of total reproducible tangible assets made up of dwellings, growth rates of real G.D.P., and per capita income levels, for a number of countries. There are two sets of estimates for the percentage of capital invested in dwellings. The first set is taken from the current-price estimates presented in Table 1-1-1. The second set is taken from the constant-price estimates presented in Table A-12. Figure 1-6-1 plots scratter diagrams for each of the four combinations of growth rates, output levels, and dwellings ratios,[29] of interest. There appears to be very little statistical correlation between growth rates and dwellings ratios, whether in 1977-78 or 1956 prices. However, there

FIGURE 1-6-1:

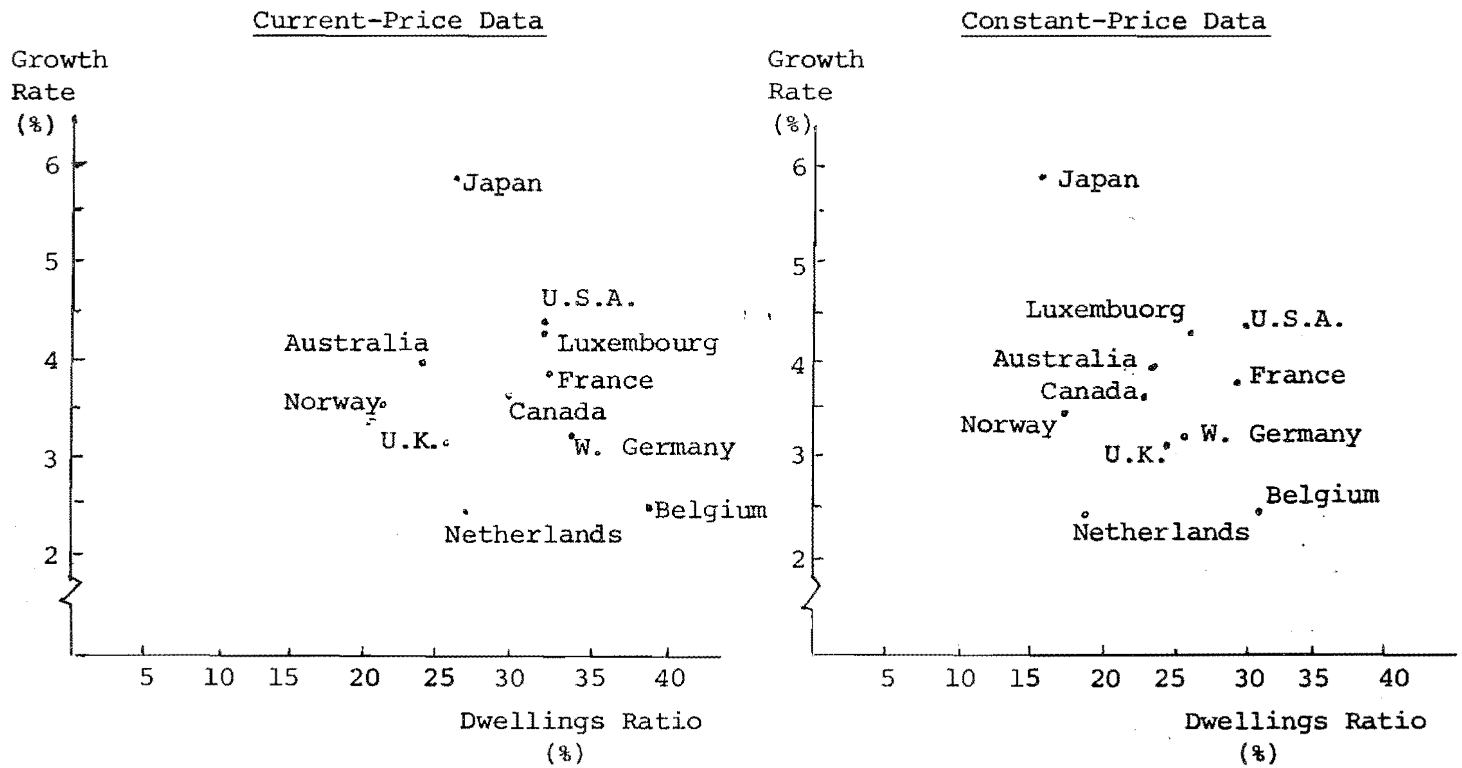
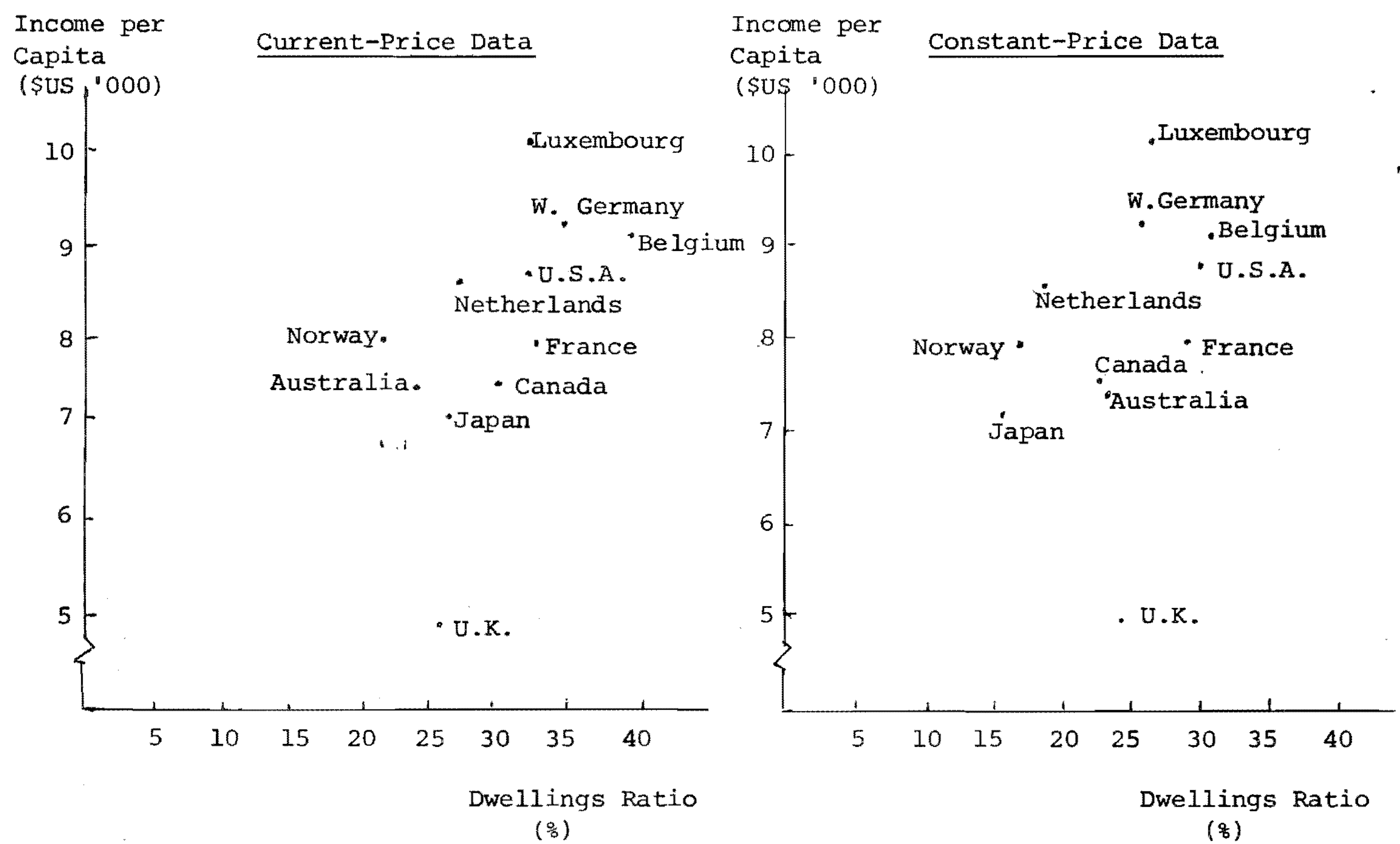

Current-Price Data
Growth Rate (%)
6
5
4
3
2
Japan
U.S.A.
Luxembourg
Australia
France
Norway
Canada
U.K.
W. Germany
Belgium
Netherlands
5 10 15 20 25 30 35 40
Dwellings Ratio (%)
Constant-Price Data
Growth Rate (%)
6
5
4
3
2
Japan
Luxembuorg
U.S.A.
Australia
France
Canada
Norway
W. Germany
U.K.
Belgium
Netherlands
5 10 15 20 25 30 35 40
Dwellings Ratio (%)

FIGURE 1-6-1 (CONT'D):



appears to be a weak positive correlation between per capital incomes and dwellings ratios. To test for the strengths of the correlations in each case, the Spearman rank correlation coefficient was calculated. The coefficients for the relationship between growth rates and dwellings ratios are negative, but are insignificant at even the 10% level. The correlation coefficient for the relationship between per capita incomes and dwellings ratios in current prices is .677, and the correlation coefficient for the relationship between per capita incomes and dwellings ratios in 1956 prices is .527. The first of these is significant at the 5% level; the second is significant at the 10% level. It is reasonable to conclude that there is a positive linear relationship between dwellings ratios and per capita income levels.

It is interesting that there is no statistical relationship between growth rates of output, and the proportion of reproducible capital employed in housing. Of course, this does not mean that government policies which encourage investment in housing have no affect on growth. Neither does it mean that any country could not achieve more rapid growth by investing less in housing.

The positive correlation between per capita income levels and dwellings ratios is not surprising: Since the income-elasticity of demand for housing exceeds unity, countries with higher per capita incomes might be expected to have larger proportions of their capital stocks devoted to this asset.

TABLE 1-6-1: Net replacement value of total dwellings as a percentage of total replacement value of net reproducible tangible wealth, 1977-1978; Current and Constant Prices; Growth Rates of Real G.D.P., 1977-78; Levels of Per Capita Income, 1977-78.

Country	Dwellings Ratio[1.]				Growth Rates		Per Capita Incomes	
	Current Prices		Constant Prices[2.]					
	%	Rank	%	Rank	%	Rank	$US	Rank
Australia	23.6	10	23.4	7	3.9[3.]	4	7467	9
Belgium	39.9	1	30.7	1	2.5	10	9025	3
Canada	29.2	6	23.2	8	3.6	6	7572	8
France	32.4	3	27.8	3	3.8	5	7918	7
West Germany	34.1	2	25.5	5	3.2	8	9278	2
Japan	26.4	8	15.8	11	5.9	1	7153	10
Luxembourg	32.2	4	25.9	4	4.3	3	10040	1
Netherlands	26.6	7	18.1	9	2.4	11	8509	5
Norway	21.8	11	17.0	10	3.5	7	7949	6
U.K.	25.7	9	24.4	6	3.1	9	4955	11
U.S.A.	32.2	4	28.8	2	4.4	2	8612	4

1. Value of dwellings as a percentage of total net reproducible tangible wealth.

2. Base year 1956.

3. 1975-76 figure

Source: Tables 1-1-2, A-12; and United Nations, Yearbook of National Accounts Statistics, 1979.

The implications of housing policy for rates of economic growth are confined to short-run (macroeconomic) and intermediate-run (adjustments to balanced growth) growth. In long-run balanced growth, the rate of growth of output is dependent upon exogenous parameters. In the Swan-Solow neoclassical growth model, for instance, the long-run rate of growth of output is the sum of the exogenous rates of population growth and labour augmenting technical progress. Taxation policies can have no effect on long-run growth rates. Never-the-less, there are some interesting issues which arise in connection with housing policy in long-run growth. The most interesting is the analysis of the dynamic incidence of the subsidy on owner-occupied housing. The long-run framework also provides an opportunity to examine the optimal taxation of housing capital.

1.7 THE SOCIAL ARGUMENTS FOR HOUSING.

There is a substantial literature which argues that quality housing and home ownership generate positive externalities which contribute to the welfare of society, and that slums generate negative externalities; so that large public investments, and tax incentives for private investment, in residential capital are justified, even if this is at the expense of economic growth and efficiency.[30] As Aaron (1970, p.803) has noted, however, the problem with these arguments is their imputation of causation: It is not clear that the beneficial effects associated with good housing are due to housing rather than to the level of income and the level of consumption in general. Observed positive correlations between "desirable" social behaviour and home ownership do not make it clear which way the causation (if any) should run. Since the income-elasticity of demand for housing exceeds unity, higher income groups will normally be "better housed", and these groups also have the financial stability associated with "desirable" social behaviour. The cause of each of these effects (i.e., good housing and desirable social behaviour) is a high level of income. Yet, as was argued in Section 2, non-neutral tax policies designed to encourage home-ownership actually reduce income levels. Clearly, there is a need to examine the effects of housing policies on the sources, as well as the uses, side of income.

An important point made in nearly all analyses of the economics of housing policy is that even if it can be shown that good housing does generate positive externalities, it is certain that there are more efficient ways of encouraging home ownership. The present exemption of imputed rentals on owner-occupied housing from taxation introduces a regressive component into the individual income tax structure: Very low income earners with a zero, or low, marginal tax rate derive little or no benefit from the exemption. The higher the marginal tax rate, the higher the value of the exemption on any particular dwelling. There is an artificial incentive created for investment in luxury housing, an asset with a very low social rate of return.[31]

1.8 PLAN OF THE WORK

Chapters 2, 3, and 4 are concerned with static analyses of housing policy. Chapters 5 and 6 explore the dynamic implications. Chapter 2 examines the investment motive in the demand for housing, and analyses the various taxation provisions relating to housing in a number of countries. Estimates of the subsidy to owner-occupied housing are then examined. Chapter 3 develops a general equilibrium model to analyse the distortions in resource allocation, and the loss of output, due to the favourable tax treatment of residential capital. A second-best tax policy is analysed, in terms of its implications for improvements in resource allocation. The model developed here identifies three sectors: Owner-occupied housing, rented housing, and "other industry". Chapter 4 applies the model to an empirical estimation of the welfare costs of the non-neutral tax treatment of income from capital, and to a re-examination of the subsidy to owner-occupied housing. The excess burden this subsidy places on other sectors is also estimated. Estimates are derived for Australia, Canada New Zealand, the United Kingdom and the United States.

Chapter 5 explores the dynamic implications of the removal of the subsidy to owner-occupied housing, in the intermediate-run. This analysis departs from the comparative static analysis of Chapters 3 and 4, by permitting sluggish adjustments of capital stocks to optimal levels. A flexible accelerator model of investment provides the formal link between the comparative statics and the dynamics.

Chapter 6 examines the question of the incidence of the owner-occupier subsidy in a long-run growth model. In addition, the optimal taxation of housing is explored. In this dynamic context, the optimal set of capital taxes is that which induces the pattern of saving consistent with "Golden Rule" growth.

Footnotes to Chapter One:

1. This concept of user cost is, of course, the concept exploited in the neoclassical investment literature: See Jorgenson (1965), (1967), and Hall and Jorgenson (1967). It differs from the concept of the same name found in Keynes', The General Theory of Employment, Interest and Money (1936). The several components of the user cost measure are discussed in detail in Chapter 2.

2. Section 1.2 lists the range of government policies which might reasonably be included in the set of "housing policies".

3. This concept is explained in Section 1.2.

4. Lee (1964) reviews the studies of the income-elasticity of demand for housing.

5. Budget of the United States Government, Fiscal Year 1981, p.180.

6. Haig (1921), Simons (1938), Hicks (1946).

7. Simons (1938, p.50).

8. Haig (1921, p.590.

9. Hicks (1946, p.172).

10. The same is true for all other consumer durables.

11. This is the interpretation offered by Simons (1938, pp.44-46).

12. Simons (1938, p.112).

13. ibid., p.113.

14. An excellent discussion of the mechanics of the United Kingdom tax appears in Willis and Hardwick (1978). Imputed rentals were taxed, briefly, in Australia, between 1915 and 1923. Reece(1975) discusses this tax.

15. Royal Commission on the Taxation of Profits and Income, 1955.

16. Willis and Hardwick (1978) note that the term "tax expenditure" was coined by Professor Stanley S. Surrey of the Harvard Law School. The criteria he established for identifying "tax expenditures" were adopted by the International Fiscal Association for its 1976 Congress. In essence, a "tax expenditure" is a loss of the tax revenue attributable to a special exemption, exclusion, or deduction, a special tax credit, or a special tax rate. According to Surrey, what is special is determined by reference to either the concept of taxation of all (Haig-Simons-Hicks type) income, or to the structure of the income tax that would exist in the absence of the tax expenditure, whichever is the weaker criterion.

17. Australian Bureau of Statistics, Survey of Housing Occupancy and Costs, Australia, August 1980 (Cat. No. 8724.0).

18. Of course, the commodity being consumed (the bundle of housing services) may also differ; being of different quantity (more or less bedrooms, for instance) or of different quality.

19. United States Department of Commerce, Bureau of the Census. Statistical Abstract of the U.S., 1977. p.282.

20. This is reported in the Canada Yearbook, 1968. No more recent figure is available.

21. United States, Department of Commerce, Bureau of the Census. Statistical Abstract of the U.S., 1977. p.530.

22. In this simple treatment it is supposed that the $1000 limit is not a binding constraint on the average individual.

23. This is the familiar area of the triangle above the demand curve.

24. Given the structure of the White & White model, the price paid by renters will fall provided the supply schedule for housing is less than infinitely elastic.

25. This is Laidler's (1969) term.

26. i.e., it does not discriminate among sectors. Chapter 3 examines the concept of "tax neutrality" in considerable detail.

27. The authors do use some of the results of Harberger's (1964a) "The measurement of waste", but those results do not relate to the general equilibrium model developed by Harberger (1962).

28. Harberger (1964b, p.

29. Defined as the percentage of total reproducible tangible assets made up of dwellings.

30. See, for example, the references in Rothenberg (1967, p.58).

31. This last point is made by Harberger (1965).

APPENDIX A-1-1: CAPITAL STOCK ESTIMATES

This appendix details the estimation of capital stock data referred to in the text. Methodology, data sources, and estimation techniques are fully described.

Methodology

Estimates are derived by application of a particular form of the perpetual inventory technique:[1] Suppose estimates of the net replacement value[2] of capital stocks are available for some base year t. Estimates for period t+1[3] might be obtained by application of the following stock-flow relationship:

$$\text{(A-1)}\quad q_{i,t+1}K_{i,t+1} = \left[\frac{q_{i,t+1}}{q_{i,t}}\right] q_{i,t}K_{i,t} + q_{i,t+1}I_{i,t+1} - q_{i,t+1}D_{i,t+1},$$

where: $q_{i,t}$ is the replacement cost of one unit of capital of type i in end-of-period t prices.

$K_{i,t}$ is the physical quantity (number of units of) capital of type i existing at the end of period t.

$I_{i,t+1}$ is the physical quantity of gross investments in capital of type i during period t+1

$D_{i,t+1}$ is the physical decay (depreciation) of capital of type i during period t+1.

$\left[\frac{q_{i,t+1}}{q_{i,t}}\right]$ is a price index used to convert period t values to prices ruling at the end of period t+1.

The expression $q_{i,t+1}I_{i,t+1}$ values gross investment in capital of type i during period t+1 at prices ruling at the end of period t+1. It is, of course, impossible to obtain data on this basis. In practice, the expression is approximated by

$$\text{(A-2)} \qquad q_{i,t+1}I_{i,t+1} \approx \int_{\pi=t}^{\pi=t+1} q_{i,\pi}I_{i,\pi}d\pi,$$

<u>where</u>: $d\pi$ is an arbitrarily small time increment.

The term $q_{i,t+1}D_{i,t+1}$ is the value of depreciation in period t+1. Data on depreciation are difficult to obtain. For this reason, it is usual to specify, a priori, a particular form of depreciation, so that estimates of actual depreciation might be obtained from other data. Here, we follow Jorgenson and Griliches (1967), and many others, in specifying an exponential pattern of depreciation, i.e., we assume that the proportion of an asset replaced during a particular period declines at a constant rate over time.[4] As is well-known, this assumption implies that

$$\text{(A-3)} \qquad K_{i,t+1} = (1-\delta_i)K_{i,t} + I_{i,t+1}$$

<u>where</u>: δ_i is the exponential decay factor.

Alternatively, we can write

$$\text{(A-4)} \qquad D_{i,t+1} = \delta_i K_{i,t+1}$$

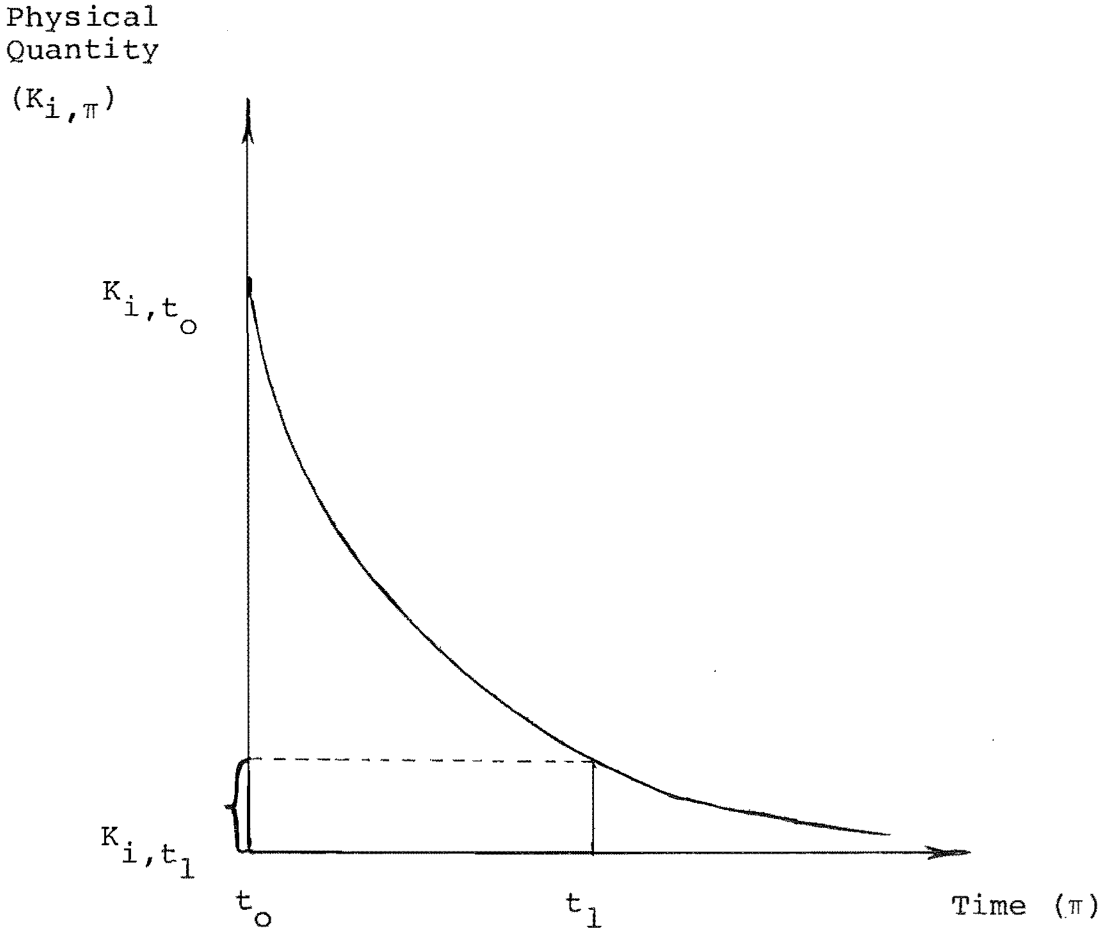
(A-4) in (A-1) produces

$$\text{(A-5)} \qquad q_{i,t+1}K_{i,t+1} = \left[\frac{q_{i,t+1}}{q_{i,t}}\right] q_{i,t}K_{i,t}(1-\delta_i) + q_{i,t+1}I_{i,t+1}$$

The pattern of depreciation implicit in (A-3) implies that assets have infinite lifetimes. This is clearly unreasonable. Because of this, applications of the perpetual inventory model sometimes specify asset lifetimes and the percentage of the physical quantity of each asset which can be supposed to be still in existence at the end of the asset's life. Once these figures have been specified, there is a unique δ_i which satisfies (A-3) for asset i. (A-5) might then be modified by subtracting from the right-hand-side the value of the remaining balance of assets which reach the end of their ascribed lifetimes in period t+1. Failure to subtract remaining balances over-states the estimates of capital stock values. These arguments are illustrated in Figure A-1. The schedule shows the balance remaining at time π on an asset of type i created at time $\pi=t_o$. $\pi=t_1$ is the ascribed time at which the asset is to be scrapped. The remaining balance to write off at that time is $K_{i,t_1}=(1-\delta_i)^{t_1-t_o}K_{i,t_o}$. Unfortunately, this exercise requires gross investment data by asset type for at least as many periods as the asset's ascribed lifetime. In the case of housing, this might be seventy years. Because of the difficulties encountered in obtaining a suitable data series, the exercise has not been performed here. In consequence, the capital stock series estimated here over-state true values, though the error is not likely to be very large.

After some manipulation, (A-5) can be generalised to produce:

FIGURE A-1: Remaining Balances Under Exponential Decay.



$$\text{(A-6)} \quad q_{i,t+x}K_{i,t+x} = \left[\frac{q_{i,t+x}}{q_{i,t}}\right] q_{i,t}K_{i,t}(1-\delta_i)^x + \sum_{j=1}^{x}(1-\delta_i)^{x-j}\left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] q_{i,t+j}I_{i,t+j}$$

$q_{i,t+x}K_{i,t+x}$ is an estimate of the net replacement value of capital of type i in period t+x. The term $\left[\frac{q_{i,t+x}}{q_{i,t}}\right] q_{i,t}K_{i,t}(1-\delta_i)^x$ is the net replacement value, in period t+x, of the stock of capital of type i in existence in period t. And the last term in (A-6) is the net replacement value, in period t+x, of the gross additions to the capital stock of type i between periods t and t+x.

Application of (A-6) requires selecting values for each of the δ_i. In addition, it requires estimates of gross investment in capital of each type for each of the periods t+1 to t+x; and it requires price indexes of the form $\left[q_{i,t+x}/q_{i,t+j}\right]$ for each period j=0,...,x.

Although the point is well known, it should be noted that the price indexes used in estimation procedures like that developed here implicitly ignore changes in asset quality. Accordingly, while the actual increase in the money value of gross investment in a particular asset between one year and the next reflects a mixture of, changes in the physical quantity of investment, changes in the quality of the investment goods, and changes in the price of the investment goods, the price indexes typically fail to distinguish between quantity and quality changes. However, models like that developed here revalue historical data using the ratios of current asset prices to original (historical) purchase prices. Hence, to the extent that the current prices reflect improvements in asset quality, historical quantity data are over-valued in current year prices. The price indexes used in the estimation below are obtained implicitly by comparing current-price, and constant-price, investment data reported in the United Nations, *Yearbook of National Accounts Statistics*. It is unlikely that the constant-price estimates reported there have been adjusted adequately for changes in asset quality.[5]

Estimation:

Capital stock estimates derived here are for each of the following four categories of tangible, reproducible, investment goods:[6] (1) Residential Structures; (2) Non-Residential Structures; (3) Equipment; (4) Inventories. Generally, estimates are the sum of assets owned by public and private enterprises. Any exceptions to this rule are noted below. The eleven countries for which estimates are obtained are, by geographical region:

Europe:	Belgium
	France
	West Germany
	Luxembourg
	Netherlands
	Norway
	United Kingdom
North America:	Canada
	United States of America
Oceania:	Australia
Asia:	Japan

Base period estimates are for years between 1950 and 1956, and have been derived from estimates presented in Goldsmith and Saunders (1959, pp.8-11). Investment data are obtained from various issues of the United Nations publication; Yearbook of National Accounts Statistics. The data presented there have in many cases been subjected to major revisions over time. Some revisions have been made to bring historical data in line with frequent revisions in the United Nations System of National Accounts. Other revisions are not explained. The data employed here reflect the most recent estimates for each year that are available in the Yearbook of National Accounts Statistics. Even so, it cannot be claimed that the data employed here exhibit perfect historical consistency. We can claim only that the errors due to such inconsistency are likely to be quite small.

The price indexes required in this exercise have been obtained by comparing current-price, and constant-price, estimates for gross investments in each type of capital, and for each year from the base year to the most recent for which investment data are available. The exception is for inventories, where, because of the techniques employed to obtain current and constant price estimates, the procedure is inappropriate.[7] The price indexes used for inventories are the same as those used for the equipment series.

Tables A-1 to A-11 present estimates of: (1) The base year values obtained from Goldsmith and Saunders (1959);

(2) $A_i \equiv \left[q_{i,t+x}/q_{i,t}\right] (1-\delta_i)^x q_{i,t} K_{i,t}$, $(i=1,2,3,4)$;

(3) $B_i \equiv \sum_{j=1}^{x} (1-\delta_i)^{x-j} \left[q_{i,t+x}/q_{i,t+j}\right] q_{i,t+j} I_{i,t+j}$, $(i=1,2,3,4)$;

and (4) $A_i + B_i \equiv q_{i,t+x} K_{i,t+x}$ $(i=1,2,3,4)$.

For each country, the exponential depreciation rates chosen are the same as those employed in the Australian study of Garland and Goldsmith (1959). These are

(1) Residential Structures: $\delta_1 = .04$

(2) Non-Residential Structures: $\delta_2 = .055$

(3) Equipment: $\delta_3 = .115$

(4) Inventories: $\delta_4 = 0$ [8].

Apart from Australia, all periods close on 31st December. The Australian closing date is 30th June. Unless otherwise noted in the tables, investment data for non-residential structures include investments in land improvement, and plantation and orchard development. Estimates for stocks of equipment include passenger cars, unless otherwise noted.

A comparison of the base-year estimates and the A_i estimates reveals that for each country the net replacement value of residential structures in existence in the base year has increased between the base year and the final year. This reflects two significant properties of housing capital; (1) it has a low rate of depreciation, and (2) there has typically been a relatively (i.e., relative to other asset-types) high rate of inflation of housing construction prices. The equipment data have moved in the opposite direction, for the opposite reasons; a high rate of

TABLE: A-1 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; Australia.

(Billion Australian dollars)[4]

Asset Type	Base Year Estimates[1] Year: 1956[5] Prices: 1956	A_i	B_i	A_i+B_i[2]
		Final Year: 1978[5] Current Prices[3]		
(1) Residential Structures	8.95[6]	11.47	49.94	61.41
(2) Non-Residential Structures	17.47[7]	18.13	87.47[9,11]	105.60
(3) Equipment	7.73[8]	1.45	60.81[10,12]	62.26
(4) Inventories	6.46	17.31	13.81	31.12
TOTAL	40.61[6]			260.39

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x q_{i,t} K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j} I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i+B_i \equiv q_{i,t+x} K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. Base year estimates have been converted from pounds to dollars. The conversion is £1 = $2.40.

5. Estimates are for 30th June.

6. Excludes dwellings owned by government enterprises and public corporations.

7. Includes government equipment.

8. Excludes government equipment.

9. Investment data excludes land improvement and plantation and orchard development.

10. Investment data includes land improvement and plantation and orchard development.

11. There is an inexplicable revision of published estimates of investment in non-residential structures between the 1971 and 1972 volumes of the U.N., Ybk of National Accounts Statistics. Data affected are those for 1960 to 1971. The most recent estimates have been used here.

12. Data published in the U.N., Ybk of National Accounts Statistics are not separated between non-residential structures and equipment for all years previous to 1960. In deriving the estimates in the table it has been assumed that the proportions in which investments were allocated in 1960 are a good approximation of allocations in earlier years, and the totals have been distributed accordingly. The price indexes developed for years previous to 1960 are extrapolations from more recent data.

TABLE: A-2 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; Belgium.

(Billion Belgian francs)

Asset Type	Base Year Estimates[1] Year: 1950 Prices: 1950	A_i	B_i	A_i+B_i[2]
		Final Year: 1978 Current Prices[3]		
(1) Residential Structures	400	611.20	2507.51	3118.71
(2) Non-Residential Structures	103[4]	105.17	2698.09	2803.26
(3) Equipment	293[4]	21.66	1359.37	1381.03
(4) Inventories	75[4]	184.80	336.54	521.34
TOTAL	871			7824.34

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x \, q_{i,t} K_{i,t}. \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j} I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x} K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. Data for general government not included.

TABLE: A-3 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; Canada.

(Billion Canadian dollars)

Asset Type	Base Year Estimates[1] Year: 1955 Prices: 1955	A_i	B_i	A_i+B_i[2]
		Final Year: 1978 Current Prices[3]		
(1) Residential Structures	12.89	19.40	149.67	169.07
(2) Non-Residential Structures	22.32	18.39	220.25	238.64
(3) Equipment	14.53	2.33	113.50	115.83
(4) Inventories	9.70	25.94	29.67	55.61
TOTAL:	59.44			579.15

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11)

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right](1-\delta_i)^x q_{i,t}K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x}\left[\frac{q_{i,t+x}}{q_{i,t+j}}\right](1-\delta_i)^{x-j} q_{i,t+j}I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x}K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

TABLE: A-4 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; France.

(Billion French francs)[4]

Asset Type	Base Year Estimates[1] Year: 1954 Prices: 1954	A_i	B_i	A_i+B_i[2]
		Final Year: 1977 Current Prices[3]		
(1) Residential Structures	89[5]	157.2	1420.9	1578.1
(2) Non-Residential Structures	122.6[6,7]	138.7	1311.3	1450.0
(3) Equipment	86.0[6]	16.1	1170.8	1186.9
(4) Inventories	57.9[6]	180.2	475.1	655.3
TOTAL:	355.5			4870.3

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11)

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right](1-\delta_i)^x q_{i,t}K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x}\left[\frac{q_{i,t+x}}{q_{i,t+j}}\right](1-\delta_i)^{x-j} q_{i,t+j}I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x}K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. Base year estimates have been converted from old to new French francs. The conversion is 1 new F.franc = 100 old F.francs.

5. Agricultural dwellings excluded.

6. General government data not available.

7. Some equipment and land included.

TABLE: A-5 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; West Germany.

(Billion Deutsch marks)

Asset Type	Base Year Estimates[1] Year: 1955 Prices: 1950	A_i Final Year: 1978 Current Prices[3]	B_i[6,7,8]	A_i+B_1[2]
(1) Residential Structures	100.0	134.3	978.0	1112.3
(2) Non-Residential Structures	114.5	84.8	992.8	1077.6
(3) Equipment	91.5[5]	6.2	764.1	770.3
(4) Inventories	42.0[4]	94.4	206.1	300.5
TOTAL:	348.0[5]			3260.7

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x q_{i,t} K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j} I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x} K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. General government data not available.

5. Excludes passenger cars.

6. Constant price data for residential and non-residential investments are not separated in the U.N., Ybk. of National Accounts Statistics, for years previous to 1966. The price indexes

developed for each of these series for earlier years are not as accurate as those developed for later years.

7. All series were subjected to major revisions between the 1976 and 1977 volumes of the U.N., <u>Ybk. of National Accounts Statistics</u>. The revisions are inexplicable. The procedure adopted here has been to use the pre-1977 estimates for all years previous to 1970, and then to use the post-1977 estimates for years 1970 to 1978. This procedure is ad. hoc., but the resulting investment series do not seem unreasonable.

8. Investment data from 1960 include data for the Saan and West Berlin. These data were not previously included.

TABLE: A-6 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; Japan

(Thousand billion yen)

Asset Type	Base Year Estimates[1] Year: 1955 Prices: 1955	A_i Final Year: 1978 Current Prices[3,5]	B_i	A_i+B_1[2]
(1) Residential Structures	2.77	4.76	132.45	137.21
(2) Non-Residential Structures	6.53	4.96	205.21[6]	210.17
(3) Equipment	3.51[4]	.43	124.89[7]	125.32
(4) Inventories	3.51	7.18	39.69	46.87
TOTAL:	16.32[4]			519.57

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x q_{i,t}K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j}I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x}K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. Excludes passenger cars.

5. Investment data for non-residential structures and equipment are not separated in U.N., Ybk of National Accounts Statistics, for years previous to 1970. In deriving the estimates in the table it has been assumed that the proportions in which investments were allocated in 1970 are a good

approximation of allocations in previous years, and the totals have been distributed accordingly.

6. Price indexes are for non-residential building only.
7. Price indexes are for machinery only.

TABLE: A-7 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; Luxembourg

(Billion Luxembourg francs)

Asset Type	Base Year Estimates[1] Year: 1950 Prices: 1950	A_i	B_i[5,6]	A_i+B_1[2]
		Final Year: 1977 Current Prices[3]		
(1) Residential Structures	17.70	48.08	89.10	137.18
(2) Non-Residential Structures	20.33 [4]	35.26	144.79	180.05
(3) Equipment	26.42 [4]	5.61	71.43	77.04
(4) Inventories	1.51	8.01	23.10	31.11
TOTAL:	65.96			425.38

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x \, q_{i,t} K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j} I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x} K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. Some inventories included.

5. Estimates for all components of gross fixed capital formation have been subjected to major, inexplicable revisions between the 1972 and 1973 volumes of the U.N., Ybk of National Accounts Statistics. Estimates for investment by-asset-type for the years 1950, 1951, 1961, 1962,

1964-67, were obtained by allocating total gross fixed capital formation (as reported in the 1972 edn. of the Ybk of National Accounts Statistics) among assets in the same proportions as for the closest year for which there are revised (i.e. 1973) estimates.

6. Constant price investment data are not available for years previous to 1966. For these years, price indexes have been developed using indexes for gross fixed capital formation by E.E.C. countries, which are available.

TABLE: A-8 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; Netherlands

(Billion guilders)

Asset Type	Base Year Estimates[1] Year: 1952 Prices: 1952	A_i	B_i	A_i+B_i[2]
		Final Year: 1978 Current Prices[3]		
(1) Residential Structures	18.3	33.8	196.5	230.3
(2) Non-Residential Structures	14.2[4,5]	15.5	240.2[8]	255.7
(3) Equipment	19.1[5,6]	1.7	152.2[9]	153.9
(4) Inventories	9.8[5,7]	21.8	205.2	227.0
TOTAL:	61.4[4]			866.9

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x \, q_{i,t}K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j}I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x}K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. Land and harbours included.

5. General government data not available.

6. Forestry included.

7. Sown seeds, growing crop and perennial plants included.

8. Price indexes are for non-residential building only.

9. Price indexes are for machinery only.

TABLE: A-9 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; Norway.

(Billion kroner)

Asset Type	Base Year Estimates[1] Year: 1953 Prices: 1953	A_i Final Year: 1978 Current Prices[3]	B_i	A_i+B_i[2]
(1) Residential Structures	22.01	28.51	113.88	142.39
(2) Non-Residential Structures	34.60	32.54	268.07[5]	300.61
(3) Equipment	21.63[4]	2.71	165.42[6]	168.13
(4) Inventories	9.6	24.03	17.71	41.74
TOTAL:	87.84			652.87

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x \, q_{i,t} K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j} I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x} K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. Excludes equipment of general government.

5. Price indexes are for non-residential building only.

6. Price indexes are for machinery only.

TABLE:A-10 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; United Kingdom.

(Billion pounds)

Asset Type	Base Year Estimates[1] Year: 1953 Prices: 1948	A_i Final Year: 1978 Current Prices[3]	B_i	A_i+B_1[2]
(1) Residential Structures	10.20	24.58	76.39	100.97
(2) Non-Residential Structures	14.03[4]	23.40	112.80[7]	136.20
(3) Equipment	.20[5]	.06	101.10[8]	101.16
(4) Inventories	5.80	30.32	24.14	54.46
TOTAL:	30.23[5]			392.79

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x q_{i,t} K_{i,t}$ $\quad$ i=1,2,3,4.

$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j} I_{i,t+j}$ $\quad$ i=1,2,3,4.

$A_i + B_i \equiv q_{i,t+x} K_{i,t+x}$ $\quad$ i=1,2,3,4.

3. Source: See Text.

4. Some equipment included; structures of coal mining excluded; most general government structures excluded.

5. Data for passenger cars not available.

6. Index for 1948 prices obtained by using a $\left[q_{1953}/q_{1948}\right]$ index for total gross fixed capital formation.

7. Price indexes are for non-residential building only.
8. Price indexes are for machinery only.

TABLE: A-11 Base year estimates, net replacement costs of base year stocks in final year, and values of net accumulations between base year and final year; United States of America.

(Billion dollars)

Asset Type	Base Year Estimates[1] Year: 1955 Prices: 1955	A_i	B_i	A_i+B_1 [2]
		Final Year: 1978 Current Prices[3]		
(1) Residential Structures	325.9	402.2	1217.2	1619.4
(2) Non-Residential Structures	342.3	304.0	1470.3[4]	1774.3
(3) Equipment	215.9	29.8	1101.8[5]	1131.6
(4) Inventories	111.3	255.7	244.5	500.2
TOTAL:	995.4			5025.5

Notes: 1. Source: Goldsmith and Saunders (1959, pp.8-11).

2. $$A_i \equiv \left[\frac{q_{i,t+x}}{q_{i,t}}\right] (1-\delta_i)^x \, q_{i,t} K_{i,t} \qquad i=1,2,3,4.$$

$$B_i \equiv \sum_{j=1}^{x} \left[\frac{q_{i,t+x}}{q_{i,t+j}}\right] (1-\delta_i)^{x-j} q_{i,t+j} I_{i,t+j} \qquad i=1,2,3,4.$$

$$A_i + B_i \equiv q_{i,t+x} K_{i,t+x} \qquad i=1,2,3,4.$$

3. Source: See Text.

4. Price indexes are for non-residential building only.

5. Price indexes are for machinery only.

depreciation, and a low rate of asset price inflation. The price effects (i.e., those due to differential rates of asset-price inflation) have been removed in Table A-12, which presents estimates of A_i,B_i, and A_i+B_i for each country in prices of 1956. The reason for presenting these estimates is that in comparing the percentage distributions of capital among asset types, for different countries, the prices in which those capital stocks are valued can significantly affect the conclusions: If one is interested in assessing the relative importance of different assets in terms of the proportion of an economy's resources devoted to those assets, concentration on nominal values can give misleading impressions. It is possible, for instance, that net investment in housing might be negative in physical terms, yet reveal a large positive investment in value terms, because of a rate of inflation of house prices which exceeds the rate of depreciation of the housing stock.

TABLE: A-12 Constant price estimates of A_i, B_i, and A_i+B_i; Various countries; Base year 1956.

Country and Asset-Type	A_i	B_i	A_i+B_i Sum	%
Australia: 1978	(Billion A. dollars)			
(1) Residential Structures	3.67	15.98	19.65	23.4
(2) Non-Residential Structures	5.07	24.44	29.51	35.1
(3) Equipment	.54	22.70	23.24	27.7
(4) Inventories	6.46	5.16	11.62	13.8
TOTAL	15.74		84.02	100.0
Belgium: 1978	(Billion B. francs)			
(1) Residential Structures	144.63	593.35	737.98	30.7
(2) Non-Residential Structures	26.95	691.46	718.41	29.9
(3) Equipment	10.79	676.98	687.77	28.6
(4) Inventories	92.03	167.60	259.63	10.8
TOTAL	274.4		2403.79	100.0
Canada: 1978	(Billion C. dollars)			
(1) Residential Structures	5.21	40.22	45.43	23.2
(2) Non-Residential Structures	6.35	76.00	82.35	42.0
(3) Equipment	.93	45.13	46.06	23.5
(4) Inventories	10.31	11.80	22.11	11.3
TOTAL	22.80		195.95	100.0
France: 1977	(Billion F. francs)			
(1) Residential Structures	37.91	342.63	380.54	27.8
(2) Non-Residential Structures	36.11	341.40	377.51	27.6
(3) Equipment	5.34	388.58	393.92	28.6
(4) Inventories	59.81	157.68	217.49	16.0
TOTAL	139.17		1369.46	100.0

TABLE A-12 (Continued)

Country and Asset-Type	A_i	B_i	A_i+B_i Sum	%
West Germany: 1978	(Billion D. marks)			
(1) Residential Structures	41.39	301.39	342.78	25.5
(2) Non-Residential Structures	31.11	364.20	395.31	29.3
(3) Equipment	3.52	434.39	437.91	32.5
(4) Inventories	53.67	117.17	170.84	12.7
TOTAL	129.69		1346.84	100.0
Japan: 1978	(Thousand billion yen)			
(1) Residential Structures	1.13	31.45	32.58	15.8
(2) Non-Residential Structures	1.93	79.97	81.90	39.6
(3) Equipment	.23	66.86	67.09	32.5
(4) Inventories	3.84	21.25	25.09	12.1
TOTAL	7.13		206.66	100.0
Luxembourg: 1977	(Billion L. francs)			
(1) Residential Structures	9.53	17.66	27.19	25.9
(2) Non-Residential Structures	7.30	37.26	44.56	42.4
(3) Equipment	1.73	21.96	23.69	22.6
(4) Inventories	2.46	7.10	9.56	9.1
TOTAL	21.02		105.00	100.0
Netherlands: 1978	(Billion guilders)			
(1) Residential Structures	7.64	44.40	52.04	18.1
(2) Non-Residential Structures	3.47	53.81	57.28	19.9
(3) Equipment	.79	71.12	71.91	25.1
(4) Inventories	10.19	95.89	106.08	36.9
TOTAL	22.09		287.31	100.0

TABLE A-12 (Continued)

Country and Asset-Type	A_i	B_i	A_i+B_i Sum	%
Norway: 1978	(Billion kroner)			
(1) Residential Structures	7.42	29.65	37.07	17.0
(2) Non-Residential Structures	9.52	78.43	87.95	40.3
(3) Equipment	1.20	73.39	74.59	34.2
(4) Inventories	10.66	7.86	18.52	8.5
TOTAL	38.80		218.13	100.0
United Kingdom: 1978	(Billion pounds)			
(1) Residential Structures	5.34	16.58	21.92	24.4
(2) Non-Residential Structures	4.88	23.5	28.38	31.6
(3) Equipment	.02	25.68	25.70	28.6
(4) Inventories	7.70	6.13	13.83	15.4
TOTAL	17.94		89.83	100.0
United States of America: 1978	(Billion dollars)			
(1) Residential Structures	133.36	403.58	536.94	38.8
(2) Non-Residential Structures	97.37	470.95	568.32	30.4
(3) Equipment	13.89	513.42	527.31	28.3
(4) Inventories	119.15	113.93	233.08	12.5
TOTAL	363.77		1865.65	100.0

Footnotes to Appendix A-1-1:

1. A general discussion of the perpetual inventory model appears in Ward (1976).

2. Net capital stock series differ from gross capital stock series in excluding the value of depreciated capital.

3. Here, and elsewhere, capital stock estimates for any period t+j are end-of-period estimates.

4. While it is sometimes argued that this assumption is restrictive, Jorgenson and Griliches (1967, at p.255) present an enlightening justification for the use of the exponential pattern of depreciation.

5. The difficulties encountered in attempts to estimate quality-adjusted constant price data series are examined in United Nations, A System of National Accounts (1968, pp.59-60).

6. Intangibles (including foreign assets) and non-reproducibles (e.g. land) are excluded.

7. For many countries annual current- and constant-price estimates for investments in inventories are the sums of quarterly data. Thus, for instance, it is not unusual for annual estimates of changes in inventories in current- and constant-prices to be of opposite sign.

8. The following schedule (taken from Garland and Goldsmith (1959, p.329)) of asset lifetimes and remaining end-of-life balances is consistent with the exponential depreciation rates used here:

Asset-Type	Assumed Life (Years)	Remaining end-of-life Balance as percentage of Original Quantity	Annual Rate of Depreciation (%)
(1) Residential Structures	70	5	4
(2) Non-Residential Structures	50	6	5.5
(3) Equipment	20	9	11.5
(4) Inventories	(unnecessary)		

CHAPTER TWO

STATIC PARTIAL EQUILIBRIUM ANALYSIS OF HOUSING POLICY

This chapter develops the "user cost" of housing capital, and indicates how this concept might be used in a partial equilibrium analysis of housing policy. Chapter 1 noted the limitations of the partial equilibrium technique, and argued that because of the quantitative significance of housing capital, that technique is not well suited to an analysis of the incidence of housing taxation policies. However, the partial equilibrium technique is widely used in studies of the housing market,[1.] and the "user cost" concept provides a useful link between partial and general equilibrium models.

Almost without exception, previous analyses of housing policy have conceived of the demand for housing as being a consumption decision only. Application of the general equilibrium model developed in Chapter 3 of this thesis requires that the demand for housing be treated as an investment decision. Investigation of the partial equilibrium implications of housing policy when the demand for housing is an investment decision, permits the general equilibrium implications of housing policy to be developed quite naturally.

Section 2.1 exploits the investment aspects of the demand for housing, and derives the "user cost" concept. Section 2.2 examines the "user cost" of housing in six Western countries; Australia, Canada, New Zealand, the

United Kingdom, the United States of America and West Germany. This section also explores the implications of the taxation of housing incomes for horizontal and vertical equity in each country. Section 2.3 explores the impacts of tax policy disturbances on the "user cost" of housing, and presents a partial equilibrium analysis of the issues in housing policy which were identified in Chapter 1.

2.1 INVESTMENT ASPECTS OF HOUSING AND THE "USER COST" OF HOUSING

Chapter 1 identified the various types of economic agents operating in the housing market: Occupiers, who consume housing services, are either owners or renters; owners, who invest in housing, are either owner-occupiers or landlords. The notion that the economic activities of owner-occupiers and landlords can be analysed in terms of an investment motive is suggested by Debreu (1959, esp. p.51). This notion is central to the analysis of this thesis. Section 2.1 derives the "user cost" expression for housing from an economic analysis of the investment decision-making of a landlord. It is then shown that (as Debreu suggests) the equilibrium conditions for the landlord are of the same form as those for the owner-occupier, and it is argued that changes in the user cost of housing will have similar qualitative impacts on both landlords and owner-occupiers.

Investment is a dynamic activity. The investment analysis presented here considers an individual landlord in a competitive environment deciding on a dynamic program of asset accumulations, and financing, throughout the foreseeable future.[2.] Asset transactions are permitted to occur continually (i.e., at every instant in continuous time). The landlord seeks to maximize the present-value of his private net worth[3.] over the time horizon $T_0 \rightarrow T_1$. At any time $s \in [T_0, T_1]$ the landlord holds a stock $K(s)$ units of housing capital.[4.] This stock of housing is rented to tenant-occupiers, and returns a rental rate of $P_K^*(s)K(s)$, where $P_K^*(s)$ is the value of gross rental payments obtained on one unit of rented housing at time s.

The rate of gross investment in housing at time s (denoted $I(s)$) is defined as the difference between the rate of acquisition of new units of housing, and the rate of disposal of old units of housing, at time s. Investment in housing is reversible here. The landlord is able to finance the costs of gross investment by making a cash payment,[5.] or by acquiring debt,[6.] such as a mortgage, over the value of net purchases. Let $\Omega(s)$ denote the proportion of the total value of gross investment at time s which is financed by the acquisition of debt. Then, $[1-\Omega(s)]q(s)I(s)$ is the cash payment made by the landlord at time s, in order to acquire the additional $I(s)$ units of housing capital; $q(s)$ is the purchase (and also re-sale) price of the housing stock.

The total value of housing held by the landlord at time s is $q(s)K(s)$. This total value can be divided into debt and equity capital. The value of debt capital held at an arbitrary time $s^* \in [T_0, T_1]$ is

$$(2\text{-}1\text{-}1) \qquad \text{Debt}\ (s^*) = \int_{s=T_0}^{s^*} [\Omega(s)q(s)I(s)-DR(s)]ds,$$

<u>where</u>:

1. It has been assumed that no debt is held prior to $s = T_0$.
2. $DR(s)$ is the rate of repayment of debt at time s.

The remainder, $q(s)K(s)\text{-Debt}(s)$, represents the landlord's (owner's) equity in housing. It is convenient to define

$$(2\text{-}1\text{-}2) \qquad \phi(s) \equiv \frac{\text{Debt}(s)}{q(s)K(s)}.$$

Then, the landlord's equity in housing at time s is

$$(2\text{-}1\text{-}3) \qquad q(s)K(s)\text{-Debt}(s) = [1-\phi(s)]q(s)K(s)$$

It is assumed that housing depreciates (physically; there is no obsolescence) exponentially at the rate δ. Accordingly, the relationship between $I(s)$ and the rate at which the stock of housing increases is given by

$$(2\text{-}1\text{-}4) \qquad \dot{K}(s) = I(s) - \delta K(s),$$

where a dot over a stock variable denotes the time rate of change of that stock. In addition, the proportion of housing subject to debt also changes over time: From (2-1-2)

$$(2\text{-}1\text{-}5) \qquad \dot{\phi}(s) = \frac{\dot{\text{Debt}}(s)}{q(s)K(s)} - \phi(s)\ \frac{\dot{K}(s)}{K(s)} + \frac{\dot{q}(s)}{q(s)}\ .$$

(2-1-5) can be reduced to more convenient notation on using (2-1-4), and on realising that

$$(2\text{-}1\text{-}6) \qquad \dot{\text{Debt}}(s) = \Omega(s)q(s)I(s)-DR(s).$$

Hence,

$$(2\text{-}1\text{-}7) \qquad \dot{\phi}(s) = \frac{I(s)}{K(s)}[\Omega(s)-\phi(s)] - \frac{DR(s)}{q(s)K(s)} + \phi(s)[\delta-\Theta(s)]$$

<u>where</u>: $\Theta(s) \equiv \frac{\dot{q}(s)}{q(s)}$ is the rate of appreciation of house prices.

The landlord chooses values for $I(s), \Omega(s)$, for all $s \in [T_0, T_1]$. (2-1-4) and (2-1-7) impose technical restrictions on the ability of these choices to affect the "state" of the asset holdings, described by $K(s), \phi(s)$. Together with the stock of housing available at time s, and the debt ratio $\phi(s)$, the decisions $I(s), \Omega(s)$, generate a rate of addition to net worth of $w[K(s), \phi(s), I(s), \Omega(s), s]$, at time s. This addition to net worth is defined as the difference between income receipts and payments. Hence:

$$(2\text{-}1\text{-}8) \qquad w[K(s),\phi(s),I(s),\Omega(s),s] = P_K^*(s)K(s) - (m+t)q(s)K(s) - \Pi(s)K(s) - DR(s) - r_m\phi(s)q(s)K(s) - [1-\Omega(s)]q(s)I(s), \quad s \in [T_0, T_1].$$

<u>where</u>: m is expenses of repairs, maintenance and casualty insurance premiums as a percentage of asset value, $q(s)K(s)$.

t is rates and local property taxes as a percentage of asset value, $q(s)K(s)$.

$\Pi(s)$ is the rate of income tax payments per unit of capital at time s.

r_m is the (nominal) mortgage rate of interest on debt.

The unit income tax rate, $\Pi(s)$ can be written

(2-1-9) $\Pi(s)=\alpha uP^*_K(s)-\beta ur_m\phi(s)q(s)-\gamma umq(s)-\varepsilon utq(s)-\zeta u\delta q(s)$
$$+\Delta\lambda(s)u\Theta(s)q(s)-R(s)$$

<u>where</u>:

u is the landlord's average rate of income tax.

$$\alpha \begin{cases} = 0 \text{ if gross rental income is not taxed.} \\ = 1 \text{ if gross rental income is taxed.} \end{cases}$$

β is the proportion of interest payments on debt which are tax deductible.

γ is the proportion of the costs of repairs, maintenance, casualty insurance premiums which are tax deductible.

ε is the proportion of rates and local property taxes which are deductible against taxable income for income tax purposes.

ζ is the proportion of the economic value of depreciation which is tax deductible.

Δ is the proportion of realised capital gains subject to income tax at the rate u.

$\lambda(s)$ is the percentage of accrued capital gains actually realised at time s.

$R(s)$ is the value of rebates[7.] against income tax liability at time s.

(2-1-9) in (2-1-8) reveals:

$$(2\text{-}1\text{-}10) \quad w(s)=(1-\alpha u)P_K^*(s)K(s)-(1-\beta u)r_m\phi(s)q(s)K(s)$$
$$-(1-\gamma u)mq(s)K(s)-(1-\varepsilon u)tq(s)K(s)+\zeta u\delta q(s)K(s)$$
$$-\Delta\lambda(s)u\Theta(s)q(s)K(s)+R(s)K(s)-DR(s)$$
$$-[1-\Omega(s)]q(s)I(s), \qquad s\in[T_0,T_1].$$

The landlord's economic problem is to choose the entire time sequence of decisions $I(s),\Omega(s)$, between T_0 and T_1, so as to maximize the present-value (evaluated at time T_0) of the stream of additions to net worth between times T_0 and T_1. The present-value of the addition to net worth of time s, evaluated at time T_0 is defined:

$$(2\text{-}1\text{-}11) \quad w[K(s),\phi(s),I(s),\Omega(s),s]^{T_0}$$
$$\equiv e^{-(1-u)r_c(s-T_0)} w[K(s),\phi(s),I(s),\Omega(s),s],$$
$$s\in[T_0,T_1].$$

<u>where</u>:

r_c is the before-tax rate of return that could be obtained by investing in an alternative asset.

(2-1-11) is easily understood by interpreting $w(s)^{T_0}$ as the sum which, if invested in an asset yielding an after-tax rate of return of $(1-u)r_c$, would produce a compounded return of $w(s)$ after $(s-T_0)$ units of time had elapsed.

The present-value of the whole stream of additions to net worth (denoted $\bar{w}[K(T_0),\phi(T_0),I,\Omega,T_0]$) is simply the sum of all the $w(s)^{T_0}$ for all $s\in[T_0,T_1]$. i.e.,

$$(2\text{-}1\text{-}12) \qquad \bar{w}[K(T_0),\phi(T_0),I,\Omega,T_0] \equiv \int_{s=T_0}^{T_1} w(s)^{T_0} ds$$

$$= \int_{s=T_0}^{T_1} e^{-(1-u)r_c(s-T_0)} w(s)ds,$$

where it is understood that I,Ω, are the functions, in the range of which are the sequences of decisions $I(s),\Omega(s)$, from the initial date T_0 to the terminal date T_1. Writing the objective functional as $\bar{w}[K(T_o),\phi(T_0),I,\Omega,T_0]$ emphasises that the present-value of net worth derived between T_0 and T_1 depends upon the initial values of the "state" variables (i.e., $K(T_0),\phi(T_0)$), and upon the changes in those "state" variables due to the decisions I,Ω.

The Pontryagin Maximum Principle[9.] has a direct application to the dynamic optimization problem presented here. With respect to the decision variables, $I(s)$ can take positive, zero, or negative values (corresponding to gross investment, replacement investment, and gross disinvestment, respectively), while $\Omega(s)$ is (by definition) contained in the closed interval from 0 to 1. A value $\Omega(s)=0$ indicates that there is no debt financing of investment, while a value $\Omega(s)=1$ indicates one-hundred percent debt financing. Formally, for $\Omega(s)$:

$$(2\text{-}1\text{-}13) \qquad \Omega(s)\in[0,1] \quad , \quad \forall s\in[T_0,T_1]$$

The Hamiltonian is derived from (2-1-4), (2-1-7), (2-1-8), (2-1-10):

$$(2\text{-}1\text{-}14)\quad H=e^{-(1-u)r_c(s-T_0)}\Big[(1-\alpha u)P_K^*(s)-q(s)K(s)[(1-\beta u)r_m\phi(s)$$
$$+(1-\gamma u)m+(1-\varepsilon u)t-\zeta u+\Delta\lambda(s)u\Theta(s)]$$
$$+R(s)K(s)-DR(s)-[1-\Omega(s)]q(s)I(s)$$
$$+\sigma_1(s)[I(s)-\delta K(s)]$$
$$+\sigma_2(s)[\frac{I(s)}{K(s)}[\Omega(s)-\phi(s)]-\frac{DR(s)}{q(s)K(s)}+\phi(s)[\delta-\Theta(s)]\Big]$$

where:

$\sigma_1(s)$ is the marginal value of housing capital at time s.

$\sigma_2(s)$ is the marginal value of the debt ratio, $\phi(s)$.

$\sigma_1(s)$ shows the rate at which an extra unit of housing available at time s would add to net worth, and $\sigma_2(s)$ shows the rate at which a unit increment in $\phi(s)$ would increase net worth. Hence, the Hamiltonian shows the rate at which decisions taken by the landlord at time s contribute to present and future increments in present-valued (at time T_0) net worth. It is the sum of the present-value of the direct increment in net worth, $w(s)^{T_0}$, and the present-value of the stream of future increments due to the changes $\dot{K}(s),\dot{\phi}(s)$, occurring at time s. It is clear that the landlord should maximize (2-1-14).

In view of (2-1-13), and (2-1-14), first-order necessary conditions for a maximum of (2-1-12) subject to (2-1-4), (2-1-7), include:

$$(2\text{-}1\text{-}15)\quad \frac{\partial H}{\partial I(s)}=-e^{-(1-u)r_c(s-T_0)}\,[1-\Omega(s)]q(s)-\sigma_1(s)$$
$$-\sigma_2(s)\frac{[\Omega(s)-\phi(s)]}{K(s)}=0$$

$$(2\text{-}1\text{-}16)\quad \frac{\partial H}{\partial \Omega(s)} = e^{-(1-u)r_c(s-T_0)}\ q(s)I(s)+\sigma_2(s)\frac{I(s)}{K(s)} \left\{\begin{matrix} \leq \\ = \\ > \end{matrix}\right\} 0,\ \text{if} \begin{cases} \Omega(s)=0 \\ 0\leq\Omega(s)\leq 1 \\ \Omega(s)=1. \end{cases}$$

$$(2\text{-}1\text{-}17)\quad \frac{\partial H}{\partial K(s)} = e^{-(1-u)r_c(s-T_0)}\sigma_1(s)\left[(1-u)r_c-\frac{\dot{\sigma}_1(s)}{\sigma_1(s)}\right]$$

$$= e^{-(1-u)r_c(s-T_0)}\Big[(1-\alpha u)P^*_K(s)-q(s)[(1-\beta u)r_m\phi(s)$$

$$+(1-\gamma u)m+(1-\varepsilon u)t-\zeta u\delta$$

$$+\Delta\lambda(s)u\Theta(s)]+R(s)-\sigma_1(s)\delta$$

$$-\sigma_2(s)\ \frac{I(s)}{K(s)}\frac{[\Omega(s)-\phi(s)]}{K(s)}-\frac{1}{K(s)}\frac{DR(s)}{q(s)K(s)}\Big]$$

$$(2\text{-}1\text{-}18)\quad \frac{\partial H}{\partial \phi(s)} = e^{-(1-u)r_c(s-T_0)}\sigma_2(s)\left[(1-u)r_c-\frac{\dot{\sigma}_2(s)}{\sigma_2(s)}\right]$$

$$= -e^{-(1-u)r_c(s-T_0)}\Big[(1-\beta u)r_m q(s)K(s)$$

$$+\sigma_2(s)\ \frac{I(s)}{K(s)}-[\delta-\Theta(s)]\Big]$$

(2-1-16) can be written:

$$(2\text{-}1\text{-}19)\qquad \sigma_2(s)\left\{\begin{matrix} \leq \\ = \\ > \end{matrix}\right\}-q(s)K(s),\ \text{if} \begin{cases} \Omega(s)=0 \\ 0\leq\Omega(s)\leq 1 \\ \Omega(s)=1. \end{cases}$$

Logarithmic differentiation of (2-1-19), with respect to time, produces (on using (2-1-4)):

$$(2\text{-}1\text{-}20)\qquad \frac{\dot{\sigma}_2(s)}{\sigma_2(s)}\left\{\begin{matrix} \leq \\ = \\ > \end{matrix}\right\}\ -\ \left[\delta-\Theta(s)-\frac{I(s)}{K(s)}\right],\ \text{if} \begin{cases} \Omega(s)=0 \\ 0\leq\Omega(s)\leq 1 \\ \Omega(s)=1. \end{cases}$$

But from (2-1-18),

$$(2\text{-}1\text{-}21) \quad \frac{\dot{\sigma}_2(s)}{\sigma_2(s)} = (1-u)r_c + \frac{(1-\beta u)r_m q(s)K(s)}{\sigma_2(s)} - \left[\delta - \Theta(s) - \frac{I(s)}{K(s)}\right]$$

(2-1-19) in (2-1-21) reveals:

$$(2\text{-}1\text{-}22) \quad \frac{\dot{\sigma}_2(s)}{\sigma_2(s)} \begin{Bmatrix} \geq \\ = \\ < \end{Bmatrix} (1-u)r_c - (1-\beta u)r_m - \left[\delta - \dot{\Theta}(s) - \frac{I(s)}{K(s)}\right], \quad \text{if} \begin{cases} \Omega(s)=0 \\ 0 \leq \Omega(s) \leq 1. \\ \Omega(s)=1. \end{cases}$$

Hence, on combining (2-1-20) and (2-1-22), necessary conditions for a maximum include:

$$(2\text{-}1\text{-}23) \quad (1-\beta u)r_m \begin{Bmatrix} \geq \\ = \\ < \end{Bmatrix} (1-u)r_c \quad ,\text{if} \begin{cases} \Omega(s)=0 \\ 0 \leq \Omega(s) \leq 1. \\ \Omega(s)=1 \end{cases}$$

Care should be exercised in interpreting (2-1-21): $r_m, \beta, u,$ and r_c are all exogenous in this problem; no decisions taken by the landlord can affect any of these variables. This implies that, in general, (2-1-21) cannot be used to determine the optimal $\Omega(s)$. But (2-1-21) does provide the landlord with information. Suppose, for instance, the landlord chooses $\Omega(s)=0$. (2-1-21) reveals that this decision can be optimal only if $(1-\beta u)r_m \geq (1-u)r_c$. Further, a choice of $\Omega(s)$ between (but not equal to either of) 0 and 1 can be optimal only if $(1-\beta u)r_m = (1-u)r_c$. And a choice of $\Omega(s)=1$ can be optimal only if $(1-\beta u)r_m \leq (1-u)r_c$. These results are easily explained: Suppose the landlord chooses $\Omega(s)=0$, but $(1-\beta u)r_m < (1-u)r_c$; i.e., the cost of acquiring funds through mortgage debt is less than the opportunity cost of own-funds (equity). In this case the landlord's decision cannot be optimal since if $(1-\beta u)r_m<(1-u)r_c$, the landlord can reduce the costs of financing investment by acquiring more debt, and so freeing more equity for investment in other assets. Indeed, as (2-1-21) reveals, if $(1-\beta u)r_m<(1-u)r_c$ the landlord will optimally choose $\Omega(s)=1$; i.e., optimality requires one-hundred percent debt financing. Similar explanations extend to the other results.

In every one of the western countries examined below, $\beta=1$. i.e., the landlord is permitted to deduct one-hundred percent of mortgage interest payments against income tax liability. r_m and r_c are given parametrically to the landlord. If capital markets are perfectly competitive, arbitrage on the part of owners of capital will ensure that $r_c=r_m$. i.e., the rate of return must be the same for all assets, including mortgage instruments. But then (2-1-23) reveals that any value of $\Omega(s)$ that satisfies (2-1-13) is optimal. This means that the proportion of gross investment that should be financed by debt is indeterminate. This result is, in fact, the celebrated Modigliani-Miller (1958) conclusion that optimal investment behaviour is independent of the type of instrument used to finance investment.[10.]

The short-run equilibrium conditions which dictate the landlord's optimal behaviour are derived from (2-1-15), (2-1-17), and (2-1-19). If (2-1-23) holds with equality, then so too must (2-1-19). (2-1-19) (with equality) in

(2-1-15) reveals:

(2-1-24) $\sigma_1(s)=[1-\phi(s)]q(s)$

i.e., optimality requires that the decision taken by the landlord equate the value of one unit of capital acquired at time s with the dollar value of equity in one unit of capital already held at time s. Comparison of (2-1-24) with (2-1-19) (with equality) reveals that, under optimality,

(2-1-25) $q(s)K(s)=\sigma_1(s)K(s)-\sigma_2(s)\phi(s)$

Recall that $\sigma_1(s)$ is the ("spot") value (evaluated at time s) of the total additions to net worth derived from one unit of capital becoming available at time s. The term $\sigma_1(s)K(s)$ is the ("spot") value of the total additions to net worth derived from K(s) units of capital being available at time s. Similarly, the term $\sigma_2(s)\phi(s)$ is the ("spot") value of the total additions to net worth derived from the total stock of debt held at time s. In consequence, (2-1-25) says that along the optimal investment path, values of $\sigma_1(s)$, $\sigma_2(s)$, satisfy equality between the stock of housing capital valued at "spot" prices (at time s), and the difference between the "spot" values (evaluated at time s), of the additions to net worth due to the total stock of housing, and the stock of housing subject to debt, available at time s.

However, while (2-1-25) is a description of investment equilibrium, it is of limited usefulness to the landlord. A more useful condition, which does not involve the unfamiliar $\sigma_1(s),\sigma_2(s)$, can be derived in the following manner. Totally differentiate (2-1-24) logarithmically, with respect to time, to obtain:

$$(2\text{-}1\text{-}26)\qquad \frac{\mathring{\sigma}_1(s)}{\sigma_1(s)}=\Theta(s)+\frac{[1\dot{-}\phi(s)]}{[1-\phi(s)]}$$

$$=\Theta(s)-\mathring{\phi}(s)/[1-\phi(s)].$$

(2-1-26) can be compared with (on using (2-1-19) and (2-1-24) in (2-1-17)),

$$(2\text{-}1\text{-}27)\qquad \frac{\mathring{\sigma}_1(s)}{\sigma_1(s)}=(1-u)r_c-\frac{(1-\alpha u)P_K^*(s)}{[1-\phi(s)]q(s)}$$

$$+\frac{q(s)[(1-\beta u)r_m\phi(s)+(1-\gamma u)m+(1-\varepsilon u)t-\zeta u\delta+\Delta\lambda(s)u\Theta(s)]-R(s)}{[1-\phi(s)]q(s)}+\delta$$

$$-\frac{K(s)}{[1-\phi(s)]}\left[\frac{I(s)}{K(s)}\frac{[\Omega(s)-\phi(s)]}{K(s)}-\frac{1}{K(s)}\cdot\frac{DR(s)}{q(s)K(s)}\right].$$

But from (2-1-7),

$$(2\text{-}1\text{-}28)\qquad \frac{K(s)}{[1-\phi(s)]}\left[\frac{I(s)}{K(s)}\frac{[\Omega(s)-\phi(s)]}{K(s)}-\frac{1}{K(s)}\cdot\frac{DR(s)}{q(s)K(s)}\right]=\frac{\mathring{\phi}(s)}{[1-\phi(s)]}$$

$$-\frac{\phi(s)[\delta-\Theta(s)]}{[1-\phi(s)]}$$

Comparing (2-1-26) with (2-1-27), on using (2-1-28), reveals:

$$(2\text{-}1\text{-}29)\qquad P_K^*(s)=q(s)\,\frac{\Big[(1-u)r_c[1-\phi(s)]+(1-\beta u)r_m\phi(s)+(1-\gamma u)m+(1-\varepsilon u)t+(1-\zeta u)\delta-(1-\Delta\lambda(s)u)\Theta(s)\Big]-R(s)}{(1-\alpha u)}$$

The right-hand side of (2-1-29) can be interpreted as the "user cost" of one unit of housing capital.[11] Denote this unit user cost by C(s). It is composed of a net opportunity cost of equity, $[(1-u)/(1-\alpha u)]r_c[1-\phi(s)]q(s)$; an interest cost on debt, $[(1-\beta u)/(1-\alpha u)]r_m\phi(s)q(s)$;

expenses of repairs, maintenance, and casualty insurance premiums, $[(1-\gamma u)/(1-\alpha u)]\, mq(s)$; the cost of rates and local property taxes, $[(1-\varepsilon u)/(1-\alpha u)]\, tq(s)$; the cost of economic depreciation, $[(1-\zeta u)/(1-\alpha u)]\, \delta q(s)$; and is diminished by the after-tax value of capital gains, $[(1-\Delta\lambda(s)u)/(1-\alpha u)]\theta(s)q(s)$, and the value of tax rebates, $R(s)/(1-\alpha u)$.

(2-1-29) states that at every instant in continuous time, optimality requires that the gross rental price $P^*_K(s)$ received by the landlord equals the unit user cost of housing. That this condition does, in fact, describe optimality might not be immediately obvious. It can be explained in the following manner: With respect to the investment decisions taken by an individual landlord in a competitive environment, every term in (2-1-29) (on both sides of the equation) is exogenous.[12.] Suppose $P^*_K(s)$ exceeds $C(s)$. Then, the landlord can increase net worth by acquiring more units of housing, and it is optimal to do so whilever $P^*_K(s)$ exceeds $C(s)$: The landlord is encouraged to accumulate housing at an infinitely rapid rate. Clearly, the existence of a finite optimal stock of housing requires that $P^*_K(s)$ does not exceed $C(s)$. Alternatively, suppose that $P^*_K(s)$ is less than $C(s)$. In this case, the landlord can increase net worth by disposing of all units of housing at the price $q(s)$. Clearly, if the landlord holds any housing at all, $P^*_K(s)$ must be at least as large as $C(s)$. Accordingly, the existence of a positive, finite, optimal stock of housing requires that $P_K^*(s)$ equals $C(s)$. But this is (2-1-29).

(2-1-29) cannot be used to determine the size of the optimal stock of housing for the individual landlord. Observations like this are not uncommon in economic theory. Perhaps the best-known result of this kind is the indeterminacy in the optimal scale of operations of the individual firm (or, equivalently, the number of firms) in a perfectly competitive industry with constant returns to scale. There does not appear to be an entirely satisfactory answer to this problem. Of course, this indeterminacy does not prevent the identification of appropriate optimality conditions for the individual firm.

(2-1-29) is a short-run equilibrium condition for the investment activity of an individual landlord. An alternative presentation of (2-1-29) is to define the net rate of return to equity invested in housing:

$$r_n \equiv \frac{(1-\alpha u)P_K^*(s)-q(s)\{(1-\beta u)r_m\phi(s)+(1-\gamma u)m+(1-\varepsilon u)t+(1-\zeta u)\delta-(1-\Delta\lambda(s)u)\Theta(s)\}+R(s)}{[1-\phi(s)]q(s)} \qquad (2\text{-}1\text{-}30)$$

Hence, on using (2-1-29), optimality can be characterized by requiring:

$$r_n = (1-u)r_c. \qquad (2\text{-}1\text{-}31)$$

The equilibrium conditions (2-1-29), (2-1-31) can be used to demonstrate that the rules for optimal investment behaviour are independent of the landlord's debt-equity ratio. (2-1-31) can be interpreted as saying that the landlord should continue to accumulate housing capital to the point where the net rate of return to his equity equals the after-tax return to equity invested in an alternative asset (the rate of opportunity cost). The rate of opportunity cost is clearly independent of $\phi(s)$. It remains to show that r_n is also independent of $\phi(s)$: Differentiate (2-1-30) with respect to $\phi(s)$, to obtain

$$\frac{\partial r_n}{\partial \phi(s)} = \frac{(1-\alpha u)P_K^*(s) - q(s)\{(1-\beta u)r_m\phi(s) + (1-\gamma u)m + (1-\varepsilon u)t + (1-\zeta u)\delta - (1-\Delta\lambda(s)u)\Theta(s)\} + R(s)}{[1-\phi(s)]^2}$$

$$- \frac{q(s)(1-\beta u)r_m}{[1-\phi(s)]},$$

which, on using (2-1-29), reveals

$$\frac{\partial r_n}{\partial \phi(s)} = \frac{(1-\alpha u)r_c q(s)}{[1-\phi(s)]} - \frac{(1-\beta u)r_m q(s)}{[1-\phi(s)]}.$$

But, $\beta = 1$, and arbitrage on the part of owners of capital ensures that $r_c = r_m$. Hence, $\partial r_n/\partial\phi(s) = 0$. This result is equivalent to Proposition III of Modigliani and Miller (1958, p.288), referred to above.

Before turning to the investment analysis of owner-occupied housing, consider an alternative interpretation of (2-1-29). This is that the landlord should hold his equity, $(1-\phi_2)q_2K_2$[13.], in housing only if, after allowing for the costs of repairs, maintenance, casualty insurance premiums, mortgage interest payments, depreciation, and taxes, but after adding the expected value of capital gains, the net return on equity invested in housing is at least as great as the net return the landlord could expect to earn if he were to invest his equity in an alternative asset. i.e., the landlord must regard

$$(2\text{-}1\text{-}32)\quad P^*_{K_2}K_2-\{r_m\phi_2+m_2+t_2+\delta_2\}q_2K_2-\Pi_2K_2+\hat{\Theta}_2q_2K_2 \geq (1-u_2)r_c(1-\phi_2)q_2K_2$$

where: $\hat{\Theta}_2$ is the expected value of Θ_2.

If (2-1-32) holds with inequality, the landlord will be encouraged to invest more equity in housing, since this will increase net worth. An equilibrium requires that (2-1-32) hold with equality. But this is (2-1-29), provided it is assumed that expected capital gains, $\hat{\Theta}_2q_2K_2$ actually accrue.[14.] In a like manner, it can be demonstrated that (2-1-29) is also the instantaneous equilibrium condition for an owner-occupier. Hence, an occupier will buy an extra unit of housing only if the costs of home ownership (mortgage interest costs, costs of repairs, maintenance, and casualty insurance premiums, depreciation, rates and local property taxes, the net opportunity cost of holding equity in housing rather than in some other asset, and any income taxes charged on imputed rent, less the expected value of capital gains) are not greater than the cost of renting a unit of housing of the same psychic value in the rental market for housing services. The cost of renting a unit of housing of the same psychic value is made up of two parts: The first is the number of units of rented housing that would provide exactly the same psychic value (in terms of utility) as one unit of owner-occupied housing; the second part is the price of each unit of rented housing. The first part is MU_1/MU_2, the ratio of the marginal utility of owner-occupied housing to the marginal utility of rented housing (i.e., the marginal rate of substitution of owner-occupied, for rented housing). The second part is $P^*_{K_2}$.

An owner-occupier must regard:

$$(2\text{-}1\text{-}33) \quad \{(1-u_1)r_c(1-\phi_1)+r_m\phi_1+m_1+\delta_1+t_1\}q_1+\Pi_1-\hat{\theta}_1q_1 \leq MU_1 \cdot \frac{P^*_{K_2}}{MU_2}$$

The term $P^*_{K_2}/MU_2$ is the cost of obtaining an extra unit of utility from rented housing. Suppose this is exogenous as far as the owner-occupier's investment decision-making is concerned. The individual will gain by investing more in owner-occupied housing whilever (2-1-33) holds with inequality. Assuming a declining marginal utility of owner-occupied housing, (2-1-33) will eventually hold with equality. Equality in (2-1-33) characterizes investment equilibrium for the owner-occupier. The right-hand-side of (2-1-33) is an obvious measure of the implicit gross rental value of one unit of owner-occupied housing. This is denoted by $P^*_{K_1}$. Hence, the equilibrium form of (2-1-33) is (2-1-29).

Any government policy which alters the "user costs" of housing for landlords or owner-occupiers will affect the optimal size of the stock of housing held by these agents, in their investment portfolios. If user costs are reduced for a landlord, he will find it optimal to acquire more units of housing, for rental; if user costs are reduced for an owner-occupier, he too will find it optimal to acquire more units of housing, for his own consumption. (2-1-29) also identifies the conditions under which an owner-occupier will find it optimal to become a landlord with respect to some or all of his housing. All that is required is that (2-1-32) holds with inequality, and that (2-1-33) does not hold. On the other hand, if (2-1-33) holds with inequality but (2-1-32) does not hold, for a particular landlord, the landlord can gain by removing a unit of housing from rental use to his private occupation.

2.2 THE "USER COSTS" OF HOUSING AND THE OWNER-OCCUPIER SUBSIDY IN SIX WESTERN COUNTRIES

The analysis of the previous Section permits the following expression for the "unit user cost" of housing employed in Sector i (i=1 denotes owner-occupied housing; i=2 denotes rented housing), in equilibrium:

$$(2\text{-}2\text{-}1) \quad C_i = q_i \; \frac{\{(1-u_i)r_c(1-\phi_i)+(1-\beta_i u_i)r_m\phi_i+(1-\gamma_i u_i)m_i +(1-\varepsilon_i u_i)t_i+(1-\zeta_i u_i)\delta_i-(1-\Delta_i\lambda_i u_i)\hat{\theta}_i\}-R_i}{(1-\alpha_i u_i)}$$

<u>where</u>: q_i is the price of one unit of housing stock in Sector i.

u_i is the average rate of individual income tax on house owners in Sector i.

r_c is the gross-of-tax rate of return that could be obtained on an alternative investment.

ϕ_i is the proportion of house value subject to debt in Sector i.

r_m is the mortgage (or other debt instrument) rate of interest.

m_i is repairs, maintenance, and casualty insurance premiums as a percentage of house value in Sector i.

t_i is rates and local property taxes as a proportion of house value in Sector i.

δ_i is the (exponential) factor of depreciation of housing in Sector i.

$\hat{\Theta}_i$ is the expected rate of capital gain on housing in Sector i.

R_i is tax rebates on one unit of housing in Sector i.

β_i is the proportion of interest payments on debt which are tax deductible in Sector i.

γ_i is the proportion of the costs of repairs, maintenance, casualty insurance premiums, which are tax deductible in Sector i.

ε_i is the proportion of rates and local property taxes which are deductible against taxable income for income tax purposes in Sector i.

ζ_i is the proportion of the economic value of depreciation which is tax deductible in Sector i.

Δ_i is the proportion of realised capital gains subject to income tax at the rate u_i.

$$\alpha_i \begin{cases} = 0 \text{ if gross rental income is not taxed.} \\ = 1 \text{ if gross rental income is taxed.} \end{cases}$$

λ_i is the proportion of accrued capital gains actually realised.

An examination of (2-2-1) reveals nine tax policy instruments, the values of which are determined by government. These are: u_i, α_i, β_i, γ_i, ε_i, ζ_i, Δ_i, t_i, and R_i. In addition, governments have some measure of influence over r_m. Each of these tax policy instruments can be used to influence the user costs of owner-occupied, and rented, housing; consequently, they can have important implications for the degrees of horizontal and vertical equity in the taxation of housing. Section 2.3 of this Chapter is concerned with the comparative partial equilibrium statics of tax policy with respect to housing. The present Section explores the implications of present tax laws in Australia, Canada, West Germany, New Zealand, the United Kingdom, and the United States of America, for horizontal and vertical equity in housing. The analysis of Section 2.2 and 2.3 indicates how the user cost concept is affected by tax policy: This analysis serves as an introduction to the general equilibrium tax incidence analysis of Chapters 3 and 4.

(a) Australia

Kiefer (1978) is the most sophisticated economic analysis of the equity implications of housing policy in Australia. The analysis is partial equilibrium. Kiefer, too, develops a user cost of capital approach, although his model differs from the model developed here. It is of particular interest that Kiefer chooses to ignore capital gains. He asserts (1978, p.128n) that the "nontaxability [of capital gains under Australian tax law] in the case of housing investment does not amount to a differential subsidy." In general, this assertion is incorrect. In particular, the change in housing costs that would be associated with the application of imputed-rent taxation to owner-occupied housing (this policy change is considered at length by Kiefer (1978)) depends critically upon the level of capital gains, even though capital gains are not taxed with or without imputed-rent taxation. The reason for this "surprising" result appears below.

The most interesting aspect of Kiefer's (1978) paper is its analysis of the implications of inflation for <u>real</u> housing costs. Kiefer concludes that inflation increases <u>real</u> housing costs at all income levels, but affects high-income homeowners more severely than low-income homeowners (i.e., it is a sort of "progressive tax"). In addition, he finds that inflation can cause the taxation of imputed rents to be regressive, unless mortgages are indexed. The treatment of capital gains in this analysis is interesting. Kiefer claims (1978, p.133) that his analysis of housing investment allows housing price increases to increase user costs, but does not allow for capital gains. There are two points that might be made about this: First, this treatment is at considerable variance with the widely accepted view that inflation encourages investment in housing because the capital gains on housing provide a "hedge" against inflation. Second, ironically, Kiefer's analysis does allow for capital gains; its limitation is that it assumes house prices increase at the same rate as all other prices, so that there are no real capital gains. Permitting real capital gains considerably strengthens Kiefer's conclusion on the progressivity of imputed-rent taxation under inflation. These points are demonstrated below.

The tax treatment of housing in Australia has a remarkable history. In 1915, the Australian Government introduced a Federal tax on the imputed income of owner-occupied housing. Reece (1975) records the administrative history of this tax. It seems that the tax was levied primarily to assist in the finance of war expenditure, although its implications for equity were recognised. Imputed income was defined to include 5% of the capital value of land and improvements used for owner occupation. The tax was removed in 1923, however.

More recently, Australian tax legislation has been (briefly) more favourable for owner-occupiers. Beginning July 1975, owner-occupiers were permitted to deduct a portion of mortgage interest from taxable incomes. But from July 1976, the deduction was allowed only to first-home buyers, and only during the first five years of ownership. Even more recently, the deduction has been withdrawn: Mortgage interest which accrues after 31 October, 1978, is not deductible, and interest payments actually made after 1 July, 1979, are not deductible. The Australian tax law contains provision for a tax rebate on rates and land tax paid on owner-occupied property: The maximum amount in respect of which a claim can be made is \$300. This claim is added to the total of other expenditures "qualifying" for a tax rebate. The rebate to which the tax payer is entitled is 32 percent of the claim, where the total of all "qualifying rebates" exceeds \$1,590.

There are no capital gains taxes on amounts realised on assets held for more than twelve months. Interest payments on debt are fully deductible as a business expense, as are rates and land tax, costs of repairs, maintenance, and casualty insurance premiums. There are, however, no depreciation allowances on residential property, whether owner-occupied or rented.

Under present Australian tax law,

$$C_1=q_1\{(1-u_1)r_c(1-\phi_1)+r_m\phi_1+m_1+t_1+\delta_1-\hat{\theta}_1\} \tag{2-2-2}$$

$$C_2=\frac{q_2\{\delta_2-\hat{\theta}_2\}}{(1-u_2)}+q_2\{r_c(1-\phi_2)+r_m\phi_2+m_2+t_2\}, \tag{2-2-3}$$

where it has been assumed that the representative owner-occupier, and landlord, avoids capital gains tax by holding property for more than twelve months. It has also been assumed that the representative owner-occupier does not qualify for the tax rebate on rates and land tax.

The unit subsidy to an owner-occupier is defined here as (the negative of) the difference between the net return to equity invested in owner-occupied housing under present law and the net return to that equity if the owner-occupier were treated in the same manner as a landlord is presently treated under the income tax.[15] This is equivalent to the difference between user costs of the owner-occupier under present law, and user costs if he were treated as a landlord is presently treated. Hence, it represents the change in tax liability if imputed-rent taxation is introduced. Kiefer claims (1978, p.132) that if there is no inflation, imputed-rent taxation is <u>neutral</u>, since it does not distort the free market investment equilibrium criterion. Put another way, the user cost of housing, with imputed rent taxation, and when all markets are in equilibrium, is independent of the tax rate. Hence, Kiefer's equation (11), re-written with present notation, is

$$(2\text{-}2\text{-}4) \qquad C_2(1)=q_1(i+\delta_1+t_1),$$

where: i is the common mortgage and opportunity rate of interest; i.e., $i=r_c=r_m$.

$C_2(1)$ is the user cost of owner-occupied housing, when owner-occupiers are treated as landlords under the income tax.

In view of (2-2-3), the value of $C_2(1)$ derived here is

$$(2\text{-}2\text{-}5) \quad C_2(1)=\frac{q_1(\delta_1-\hat{\Theta}_1)}{1-u_1}+q_1\{r_c(1-\phi_1)+r_m\phi_1+m_1+t_1\}$$

$$=\frac{q_1(\delta_1-\hat{\Theta}_1)}{1-u_1}+q_1(i+m_1+t_1).$$

To see the relationship between (2-2-4), which is Kiefer's expression, and (2-2-5), note that Kiefer compresses δ_1 and m_1, and his interpretation of imputed-rent taxation permits full deductibility of depreciation. Making these adjustments, (2-2-5) is

$$(2\text{-}2\text{-}6) \qquad C_2(1)=q_1(i+\delta_1+t_1)-\frac{\hat{\theta}q_1}{1-u_1}.$$

If there are no <u>real</u> capital gains on housing (i.e., capital gains in excess of general inflation), Kiefer's assumption of no inflation implies $\hat{\theta}$ is zero, and there is no difference between (2-2-4) and (2-2-6). But in general, there will be <u>real</u> capital gains (or losses) on housing.

A comparison of (2-2-5) and (2-2-4) reveals two incorrect results in Kiefer (1978): The first "result" is that capital gains do not matter, in general. The second is that if there is no inflation, imputed-rent taxation (i.e., the particular form used by Kiefer) is neutral. (2-2-6) reveals that the second of these results is true only if there are no <u>real</u> capital gains (or losses) on housing, which will not be true, in general. In fact, if there are <u>real</u> capital gains on housing, (2-2-6) indicates that imputed-rent taxation, with no taxation of capital gains, is regressive: Under a system of progressive income taxation, high-income homeowners receive favourable treatment, relative to low-income homeowners. The first "result" is incorrect: Kiefer's definition of the subsidy to owner-occupied housing compares taxation under present law with imputed-rent taxation. Denoting the unit subsidy (subsidy per unit of housing capital) by S, Kiefer's definition implies

(2-2-7) $$S \equiv C_2(1) - C_1$$

$$= q_1\left(\frac{\bar{u}_1}{1-\bar{u}_1}\right)\{(1-u_1)r_c(1-\phi_1)-\hat{\theta}_1\}$$

<u>where</u>: $\bar{u}_1$ is the marginal (rather than the average) tax rate of the owner-occupier.

(The marginal tax rate $\bar{u}_1$ is used because the size of a tax change under a progressive income tax system depends upon marginal, not average, tax rates). The definition of the subsidy to owner-occupied housing given here, implies

(2-2-8) $$S = q_1\left(\frac{\bar{u}_1}{1-\bar{u}_1}\right)\{(1-\bar{u}_1)r_c(1-\phi_1)+\delta_1-\hat{\theta}_1\},$$

which differs from (2-2-7) because of the nondeductibility of depreciation on rented housing in the Australian income tax. (2-2-7) and (2-2-8) reveal that the size of the subsidy to owner-occupied housing depends critically upon the rate of capital gain, $\hat{\theta}_1$. The reason for this result, which contradicts the assertion made by Kiefer, is that capital gains reduce equilibrium rentals, which are taxed on rented housing, but which are not taxed on owner-occupied housing. Capital gains favour landlords over owner-occupiers. This result is returned to, below.

Kiefer's treatment of inflation is interesting. His principal conclusion is that the taxation of nominal net rent in the presence of inflation is generally not neutral.

Kiefer considers the special case in which all prices (including house prices) increase at the same rate (denote this rate by $\tilde{\Theta}$), so that

$$P^*_{K_1}(s) = P^*_{K_1}(0)e^{\tilde{\Theta}s}$$

$$q_1(s) = q_1(0)e^{\tilde{\Theta}s}$$

It is then argued that capital market equilibrium requires all asset-holders (including lenders) to maintain real after-tax rates of return in the presence of inflation. Denote this real rate of return (real discount rate) for mortgagees by ρ_0^m, and for homeowners by ρ_0. The relationships between $r_m, r_c, \rho_0^m, \rho_0$, are:

(2-2-9) $$\rho_0^m = (1-u_m)r_m - \tilde{\Theta}$$

where: u_m is the mortgagee's tax rate,

(2-2-10) $$\rho_0 = (1-u_1)r_c - \tilde{\Theta}$$

(2-2-11) $$r_m = r_c = i.$$

Finally, define the before-tax real interest rate:

(2-2-12) $$i_0 \equiv \rho_0^m/(1-u_m).$$

Kiefer is interested in the implications of inflation for real housing costs. He considers (pp.133-134) a simple example in which $\delta_1 = t_1 = m_1 = 0$; then, he finds that

(2-2-13) $$C_2(1)_0 = q_1(0)\left[i_0 + \tilde{\Theta}\left[\frac{1}{1-u_m} - \frac{1}{1-u_1}\right]\right],$$

where: $C_2(1)_0$ ($=P^*_K(0)$ in equilibrium) is the real cost of housing, under imputed-rent taxation, in the presence of inflation.

(2-2-13) reveals that if $u_m \neq u_1$, high bracket homeowners receive relatively favourable treatment under a system of progressive taxation. i.e., imputed-rent taxation is not neutral if there is inflation.

Kiefer's result (2-2-13) is derived on the assumption that all prices appreciate at the same rate. More generally, there may be real capital gains (or losses) on housing, i.e., in general $\tilde{\Theta} \neq \hat{\Theta}$. Hence, suppose

$$P^*_{K_1}(s) = P^*_{K_1}(0)e^{\tilde{\Theta}s}$$

$$q_1(s) = q_1(0)e^{\hat{\Theta}_1 s}.$$

Then, making all Kiefer's other assumptions, (2-2-10), (2-2-11), in (2-2-6) reveal

$$(2\text{-}2\text{-}14) \qquad C_2(1)_0 = q_1(0)\left[i-\frac{\hat{\Theta}_1}{1-u_1}\right]$$

$$= q_1(0)\left[\frac{\rho_0}{1-u_1}\right] - q_1(0)\left[\frac{\hat{\Theta}_1-\tilde{\Theta}}{1-u_1}\right].$$

On using (2-2-9) and (2-2-12), (2-2-14) reveals:

$$(2\text{-}2\text{-}15) \qquad C_2(1)_0 = q_1(0)\left[i_0+\tilde{\Theta}\;\frac{1}{1-u_m}-\frac{1}{1-u_1}\right] - q_1(0)\left[\frac{\hat{\Theta}_1-\tilde{\Theta}}{1-u_1}\right].$$

Hence, (2-2-15) is a generalization of (2-2-13), to permit real capital gains. Again, it is clear that capital gains do matter, in general. In fact, the possibility of real capital gains on housing strengthens Kiefer's result, since then imputed-rent taxation is not neutral under inflation even if $u_m = u_1$; it is not neutral even if homeowners have one-hundred percent equity in their homes.

This last result is of considerable interest, since it indicates that making only real interest payments both deductible for borrowers and taxable for lenders is not generally sufficient to ensure the neutrality of imputed-rent taxation in the presence of inflation. Yet both Swan (1976, p.175) and Kiefer (1978, p.134) claim that it is. (2-2-15) can be used to show that, in addition, there must be full taxation of real capital gains on an accruals basis.

In the rest of this Section, attention focuses on nominal, rather than real, user costs of housing. The real rate of interest, denoted $r_0(\equiv r_c-\tilde{\Theta})$, and the real rate of capital gain, $(\hat{\Theta}-\tilde{\Theta})$, are identified, however.

The unit subsidy on owner-occupied housing, under Australian income tax legislation, is shown in (2-2-8). The subsidy is a measure of the horizontal inequity created by the favourable tax treatment of investment income on owner-occupied housing. Since $\bar{u}_1<1$, the subsidy is positive/zero/negative as

(2-2-16) $$r_0-(\hat{\Theta}_1-\tilde{\Theta}) \gtreqless r_c\{1-(1-\bar{u}_1)(1-\phi_1)\}-\delta_1.$$ [16]

Hence, the question of whether owner-occupied housing is subsidized relative to rented housing (i.e., if there is horizontal inequity as between housing tenures) under Australian tax legislation, depends (among other things) upon the size of the difference between the real rate of interest (this is the real income yield of the investment) and the real rate of capital gain. The lower the real rate of interest, the less likely it is that owner-occupied housing is subsidized. It is possible to discover a critical real interest rate (denoted $\bar{r}$) at which there is no subsidy. In view of (2-2-16) this critical real interest rate is

$$\bar{r} = r_c\{1- (1-\bar{u}_1)(1-\phi_1)\}-\delta_1+(\hat{\Theta}_1-\tilde{\Theta}).$$

If the real rate of interest exceeds this critical value, the subsidy is positive; if the real interest rate is less than this critical value, the subsidy is negative.

To test for vertical inequity in the Australian tax treatment of housing income, differentiate (2-2-8), with respect to $\bar{u}_1$:

$$\text{(2-2-17)} \qquad \frac{\partial S}{\partial \bar{u}_1} = q_1\left[r_c(1-\phi_1)+\frac{\delta_1-\hat{\Theta}_1}{(1-\bar{u}_1)^2}\right] \gtreqless 0 \text{ as}$$

$$r_0-(\hat{\Theta}_1-\tilde{\Theta}) \gtreqless r_c\{1-(1-\bar{u}_1)^2(1-\phi_1)\}-\delta_1$$ [16].

where $q_1, r_c, \phi_1, \delta_1, \hat{\Theta}_1$, have all been treated (parametrically) as exogenous constants. Clearly, the partial derivative might be positive, zero, or negative, depending upon the relationship between $\bar{u}_1$, r_c, ϕ_1, δ_1, and $\hat{\Theta}_1$.

Table 2-2-1 presents some illustrative calculations of the size of $S.K_1$ (this is the annual value of the owner-occupier subsidy for an individual with K_1 units of housing) in each of the six Western countries examined in this Section. The subsidy is calculated using the following

TABLE 2-2-1: The Subsidy to Owner-Occupied Housing; Some Illustrative Calculations; Six Western Countries. (Dollars per annum.)

Country	Real Rate of Interest r_0	Marginal Tax Rate ($\bar{u}_1$) 0	.10	.20	.30	.40	.50	.60	.70
Australia	$\bar{r}$	*	.0425	.05	.0575	.065	.0725	.08	.0875
	0	0	-283.33	-750	-1478.57	-2600	-4350	-7200	-12250
	.05	0	50	0	-192.86	-600	-1350	-2700	-5250
	.10	0	383.33	750	1092.86	1400	1650	1800	1750
	.15	0	716.67	1500	2378.57	3400	4650	6300	8750
Canada	$\bar{r}$	*	.015	.03	.045	.06	.075	.09	.105
	0	0	-50	-225	-578.57	-1200	-2250	-4050	-7350
	.05	0	116.67	150	64.29	-200	-750	-1800	-3850
	.10	0	283.33	525	707.14	800	750	450	-350
	.15	0	450	900	1350	1800	2250	2700	3150
New Zealand	$\bar{r}$	*	-.0675	.0233	.0586	.08	.0958	.1089	.1204
	0	1000	450	-350	-1507.14	-3200	-5750	-9800	-16850
	.05	1000	783.33	400	-221.43	-1200	-2750	-5300	-9850
	.10	1000	1116.67	1150	1064.29	800	250	-800	-2850
	.15	1000	1450	1900	2350	2800	3250	3700	4150
United Kingdom	$\bar{r}$	*	.2375	.47	*	-.37	-.1375	-.05	.0013
	0	0	3166.67	3525	3728.57	3700	3300	2250	-100
	.05	0	2500	3150	3728.57	4366.67	4500	4500	3900
	.10	0	1833.33	2775	3728.57	4700	5700	6750	7900
	.15	0	1166.67	2400	3728.57	5200	6900	9000	11900
U.S.A.	$\bar{r}$	*	-.0063	.0033	.0141	.0263	.04	.0557	.0738
	0	0	40	-45	-308.57	-840	-1800	-3510	-6720
	.05	0	356.67	630	784.29	760	450	-360	-2170
	.10	0	673.33	1305	1877.14	2360	2700	2790	2380
	.15	0	990	1980	2970	3960	4950	5940	6930
West Germany	$\bar{r}$	.12	.123	.126	.129	.132	.135	.138	.141
	0	0	-820	-1890	-3317.14	-5280	-8100	-12420	-19740
	.05	0	-486.67	-1140	-2031.43	-3280	-5100	-7920	-12740
	.10	0	-153.33	-390	-745.71	-1280	-2100	-3420	-5740
	.15	0	180	360	540	720	900	1080	1260

Source: See Text

Data: q_1K_1 = \$60,000; $\phi_1 = .5$; $r_c = r_m = .15$; $\delta_1 = .04$; $t_1 = .015$.

* $\bar{r}$ is not defined for this value of $\bar{u}$.

data: It is assumed that the individual has 50 percent owner's equity in a \$60,000 house; the (gross-of-tax) mortgage rate of interest equals the (gross-of-tax) opportunity rate of interest, equals 15 percent; the rate of (exponential) depreciation on housing is 4 percent per annum. Calculations are performed for a range of different values of $\bar{u}_1$, and r_0, but it is supposed that there are no real capital gains on housing (of course, this is unrealistic, but any other precise value is difficult to discover, empirically), so that $\hat{\theta}_1=\tilde{\theta}$.

Table 2-2-1 shows, for each country, the critical real rate of interest, $\bar{r}$, for different marginal tax rates. This critical real interest rate increases with the individual marginal tax rate. Hence, for instance, under Australian tax legislation, if the hypothetical individual faces a marginal tax rate of 60 percent, he enjoys an owner-occupier subsidy only if the real rate of interest exceeds 8 percent. If, however, the individual faces a marginal tax rate of 30 percent, he enjoys an owner-occupier subsidy provided the real rate of interest exceeds 5.75 percent.

In the special case of no inflation (and, hence, a real rate of interest of 15 percent), the Australian tax treatment of owner-occupied housing exhibits vertical inequity: An individual facing a marginal tax rate of 60 percent enjoys an owner-occupier subsidy of \$6300 p.a. (approximately \$121/week), while an individual facing a marginal tax rate of 30 percent enjoys a subsidy of

$2378.57 p.a. (approximately $46/week). In terms of pre-tax income, the subsidy to the individual with a marginal tax rate of 60 percent is approximately $303/week. This means that the present tax treatment of owner-occupied housing for this individual is equivalent to taxing owner-occupied housing in the same way that rented housing is taxed, and giving this individual a cash handout of $303/week. The subsidy in terms of pre-tax income is approximately $65/week for the individual with a 30 percent marginal tax rate; this is $238/week less than for the individual with the 60 percent marginal tax rate.

While the subsidy to owner-occupied housing can be quite large under Australian tax legislation, it is not clear that the subsidy is large in general. Real rates of interest have typically been very low (even negative) in recent years. Even a 5 percent real rate of interest seems high, historically. But at this real rate of interest, the only individuals enjoying a subsidy from owner-occupied housing are those with marginal tax rates less than 20 percent. Table 2-2-1 displays this result.

The reason that landlords can be treated favourably relative to owner-occupiers under the Australian income tax derives from the tax treatment of capital gains. Relative to owner-occupiers, landlords derive proportionately more of their after-tax incomes from tax free capital gains.

(b) Canada

According to Canadian tax legislation effective as at 15th December, 1980, imputed rentals on owner-occupied housing are not taxed. Generally, one-half of "taxable capital gains" are included in the tax-payer's income and taxed at the normal income tax rate. Capital gains are not taxed as they accrue, but rather, as they are realised. Capital gains realised by an owner-occupier on the sale of his "principal residence" are, however, not taxable, although gains realised by a landlord on the sale of rented property are. The costs of property taxes, repairs, maintenance, casualty insurance premiums, mortgage interest payments, and depreciation are tax deductible on property purchased as an investment, provided the taxpayer made the outlays with the intention of producing actual (as distinct from notional/imputed) income.

The Canadian tax provisions imply:

$$(2\text{-}2\text{-}18) \qquad C_1 = q_1\{(1-u_1)r_c(1-\phi_1)+r_m\phi_1+m_1+t_1+\delta_1-\hat{\theta}_1\},$$

which is the same as under Australian legislation; and

$$(2\text{-}2\text{-}19) \qquad C_2 = q_2\{r_c(1-\phi_2)+r_m\phi_2+m_2+t_2+\delta_2\}-\frac{q_2(1-\tfrac{1}{2}\lambda_2u_2)\hat{\theta}_2}{(1-u_2)}$$

where: 1. It has been assumed that depreciation allowances for tax purposes reflect actual economic depreciation.

2. λ is the percentage of expected capital gains actually realised in the tax period.

The unit subsidy on owner-occupied housing under Canadian tax law is:

$$(2\text{-}2\text{-}20)\qquad S=q_1\left[\frac{\bar{u}_1}{1-\bar{u}_1}\right]\{(1-\bar{u}_1)r_c(1-\phi_1)-(1-\tfrac{1}{2}\lambda_1)\hat{\theta}_1\} \gtreqless 0 \text{ as}$$

$$r_0-(\hat{\theta}_1-\tilde{\theta}) \gtreqless r_c\{1-\frac{(1-\bar{u}_1)(1-\phi_1)}{(1-\frac{1}{2}\lambda_1)}\}$$ [16]

The critical real interest rate is $\bar{r} = r_c\{1-\frac{(1-\bar{u}_1)(1-\phi_1)}{(1-\frac{1}{2}\lambda_1)}\}$ $+(\hat{\theta}_1-\tilde{\theta})$. If the real rate of interest exceeds this value, owner-occupied housing enjoys a positive subsidy. An examination of (2-2-20) reveals that the size of the subsidy depends upon the percentage of accrued capital gains actually realised. From (2-2-20):

$$(2\text{-}2\text{-}21)\qquad \frac{\partial S}{\partial \lambda_1} = \tfrac{1}{2}\hat{\theta}_1 q_1\left[\frac{\bar{u}_1}{1-\bar{u}_1}\right] \gtreqless 0 \text{ as } \hat{\theta}_1 \gtreqless 0$$

This result is not surprising. It arises because of the favourable tax treatment of realised capital gains on owner-occupied housing, relative to rented housing.

To test for vertical inequity, differentiate (2-2-20), with respect to $\bar{u}_1$:

$$(2\text{-}2\text{-}22)\qquad \frac{\partial S}{\partial \bar{u}_1} = q_1\{r_c(1-\phi_1)-\frac{(1-\frac{1}{2}\lambda_1)\hat{\theta}_1}{(1-\bar{u}_1)^2}\} \gtreqless 0 \text{ as}$$

$$r_0-(\hat{\theta}_1-\tilde{\theta}) \gtreqless r_c\{1-\frac{(1-\bar{u}_1)^2(1-\phi_1)}{(1-\frac{1}{2}\lambda_1)}\}$$ [16]

Some illustrative calculations for the Canadian case are presented in Table 2-2-1. It has been assumed that $\lambda_1 = 1$; i.e., that all capital gains are realised as they accrue. Calculations of the subsidy to owner-occupied housing under alternative assumptions about λ_1 can easily be performed, and compared with the calculations presented here. As (2-2-21) reveals, an assumption of $\lambda_1=1$ tends to overstate the size of the owner-occupier subsidy.

A comparison of the illustrative calculations for Canada, with those performed for Australia, reveals that for those combinations of $\bar{u}_1$ and r_0 for which the subsidy is positive in both countries, the subsidy is nearly always larger in Australia. The Australian tax system also exhibits more vertical inequity, for any real interest rate. Table 2-2-1 reveals, for example, that if there is no inflation, the subsidy for an individual with a marginal tax rate of 60 percent is \$1350 p.a. larger than for an individual with a marginal tax rate of 30 percent. This compares with a difference of approximately \$3921 p.a. under Australian tax legislation.

(c) New Zealand

According to New Zealand tax legislation embodied in the Income Tax Act, 1976 (as amended), imputed rentals on owner-occupied housing are not taxed. Provided the tax-payer does not acquire property with the primary intention of later realising a capital gain on that property, there is no capital gains tax liability. Normal costs of repairs, maintenance, casualty insurance premiums, depreciation, rates, and mortgage interest payments are tax deductible for landlords, but not owner-occupiers. However, as from 1 April 1981, there has been provided a tax rebate of one-half of mortgage interest payments made by owner-occupiers in the first five years of owner-occupation. The total value of the tax rebate is not to exceed \$1000 per annum. The stated aim of this recent tax initiative is to encourage low income families to acquire their own homes. The "user cost" measure provides an indication of the likelihood that this tax policy will achieve its objective.

The New Zealand tax provisions imply that for home owners who have been owner-occupiers for more than five years:

$$(2\text{-}2\text{-}23) \quad C_1 = q_1\{(1-u_1)r_c(1-\phi_1)+r_m\phi_1+m_1+t_1+\delta_1-\hat{\theta}_1\},$$

which is the same as under Australian and Canadian tax legislation. But for those owner-occupiers who have been homeowners for less than five years:

$$(2\text{-}2\text{-}24) \quad C_1 = q_1\{(1-u_1)r_c(1-\phi_1)+r_m\phi_1+m_1+t_1+\delta_1-\hat{\theta}_1\} - \frac{1}{K_1}\min\{r_m\phi_1 q_1 K_1, 1000\}$$

where K_1 represents the number of units of housing capital in the house owned by the owner-occupier.

For landlords,

$$(2\text{-}2\text{-}25) \quad C_2 = q_2\{r_c(1-\phi_2)+r_m\phi_2+m_2+t_2+\delta_2\}-\frac{q_2\hat{\theta}_2}{(1-u_2)}.$$

In deriving (2-2-23), (2-2-24), and (2-2-25) it has been assumed, realistically, that the representative landlord and owner-occupier is not subject to capital gains tax on realised capital gains.

The subsidy to owner-occupied housing depends upon which of (2-2-23), (2-2-24), is accepted as the unit user cost of owner-occupied housing. In the first case

$$(2\text{-}2\text{-}26) \quad S = q_1\left(\frac{\bar{u}_1}{1-\bar{u}_1}\right)\{(1-\bar{u}_1)r_c(1-\phi_1)-\hat{\theta}_1\} \gtreqless 0 \text{ as}$$

$$r_0-(\hat{\theta}_1-\tilde{\theta}) \gtreqless r_c\{1-(1-u_1)(1-\phi_1\}.^{16.}$$

In the second case

$$(2\text{-}2\text{-}27) \quad S = q_1\left(\frac{\bar{u}_1}{1-\bar{u}_1}\right)\{(1-\bar{u}_1)r_c(1-\phi_1)-\hat{\theta}_1\}+\frac{1}{K_1}\text{x}\min\{r_m\phi_1 q_1,1000\}$$

$$\gtreqless 0 \text{ as } r_0-(\hat{\theta}_1-\tilde{\theta})\gtreqless r_c\{1-(1-\bar{u}_1)(1-\phi_1)\}$$
$$-\frac{(1-\bar{u}_1)}{\bar{u}_1 q_1 K_1}\min\{\tfrac{1}{2}r_m\phi_1 q_1 K_1,1000\}^{16.}$$

Clearly, provided the individual has some mortgage debt in his house ($\phi_1>0$), the owner-occupier subsidy is larger in the second case.

The unit subsidy implied by New Zealand tax legislation can be compared with the subsidies implied by Australian and Canadian legislation. The unit subsidy in (2-2-26) is less than the unit subsidy under Australian tax legislation because landlords are permitted depreciation allowances in New Zealand, but not in Australia. The subsidy is larger under Canadian legislation only if

$\lambda_1>0$; i.e., only if some capital gains are realised as they accrue. Care should be taken in interpreting these comparisons: A larger owner-occupier subsidy under Australian (or Canadian) tax legislation does not mean that owner-occupiers would benefit from a move from New Zealand to Australian tax legislation, since the unit user cost of owner-occupancy is the same in both cases (and, also, in the Canadian case).[17.] The unit subsidy in (2-2-27) might be larger than under Australian and Canadian tax legislations. With respect to Australian legislation, this requires

$$\min\{\tfrac{1}{2}r_m\phi_1 q_1 K_1, 1000\} > q_1 K_1 \delta_1 \left(\frac{\bar{u}_1}{1-\bar{u}_1}\right);$$

while, with respect to Canadian legislation, this requires

$$\min\{\tfrac{1}{2}r_m\phi_1\ q_1 K_1, 1000\} > \left(\frac{\bar{u}_1}{1-\bar{u}_1}\right)\tfrac{1}{2}\lambda_1\hat{\theta}_1 q_1 K_1.$$

According to the hypothetical data employed in Table 2-2-1, the unit subsidy in (2-2-27) is greater than under Australian legislation only if $\bar{u}_1<.294$, and it is greater than under Canadian legislation only if $\bar{u}_1<1/[5.5-30(r_c-\hat{\theta}_1)]$. These relationships are illustrated in Table 2-2-1. In that Table, the unit subsidy used for New Zealand is that presented in (2-2-27).

To test the implications of New Zealand tax legislation for vertical equity, differentiate (2-2-26), (2-2-27), with respect to $\bar{u}_1$, to obtain

$$(2\text{-}2\text{-}28) \quad \frac{\partial S}{\partial \bar{u}_1} = q_1\{r_c(1-\phi_1) - \frac{\hat{\theta}_1}{(1-\bar{u}_1)^2}\} \gtreqless 0 \text{ as } r_0 - (\hat{\theta}_1 - \tilde{\theta}) \gtreqless r_c\{1-(1-\bar{u}_1)^2(1-\phi_1\},$$ [16].

in both cases. It is interesting that the degree of discrimination among individual owner-occupiers with different marginal tax rates is unaffected by the recent policy initiative designed to encourage low-income earners to become owner-occupiers. The reason is that the policy does not discriminate among individuals of different incomes: Every individual who qualifies for the tax rebate receives the same additional unit subsidy, regardless of his income.

(d) United Kingdom

Imputed rent on owner-occupied housing has not been taxed since 1963. Realised capital gains are taxed at a rate of 30 percent of the value of those gains, but owner-occupiers are exempt from capital gains tax liability on the disposal of their only or main residence (or of a residence provided for a dependent relative). There are also generous "roll-over" provisions on transactions in business assets, which effectively postpone liability for capital gains tax whilever all of the realised gains are used to purchase property for a similar purpose. Landlords are permitted to deduct costs of repairs, maintenance, casualty insurance premiums, rates and local property taxes. There are no depreciation allowances on residential property, but mortgage interest payments are tax deductible (up to a ceiling of £25,000), regardless of whether the owner is landlord or owner-occupier.

The most remarkable feature of the United Kingdom housing market is the importance of local authority housing, however. At the end of 1977, 56% of dwellings were owner-occupied, 31% rented from local authorities, and only 13% were rented privately. In terms of capital value, approximately 38% of the total housing stock value of £153.9 billion was invested in local authority housing at the end of 1978 (King and Atkinson (1980, p.9)).

King and Atkinson (1980) estimate a net rate of return on local authority housing of 2.09% in 1978. The estimate assumes management costs of 0.2 percent of the value of housing stock, repairs and maintenance of 0.3 percent of stock, depreciation of 1.27 percent of stock, and a real rate of capital gain of 1 percent per annum. Following King and Atkinson, this might be interpreted as the "target" rate of return on local authority housing. Comparing this rate of return with rates of return earned elsewhere in the economy indicates the extent to which local authority housing is subsidized. This "target" rate of return might be expressed algebraically as

$$r_4(1-\phi_4)$$

<u>where</u>: 1. The subscript "4" denotes local authority housing.

2. r_4 is the "target" interest rate on equity in local authority housing.

The relationship between local authority rentals and the target rate of return is, from (2-1-30)

$$r_4=\frac{(1-\alpha_4u_4)P^*_{K_4}-q_4\{(1-\beta_4u_4)r_m\phi_4+(1-\gamma_4u_4)m_4+(1-\varepsilon_4u_4)t_4+(1-\zeta_4u_4)\delta_4-(1-\Delta_4\lambda_4u_4)\hat{\theta}_4\}+R_4}{(1-\alpha_4u_4)} \tag{2-2-29}$$

The target rate of return can be expressed as

$$r_4 = r_c-(r_c-r_4) \tag{2-2-30}$$

<u>where</u>: (r_c-r_4) is the difference between the social rate of opportunity cost and the target rate of return earned on capital employed in local authority housing.

The social return to an investment of $(1-\phi_4)q_4K_4$ dollars of society's resources in local authority housing is

$$r_4(1-\phi_4)q_4K_4+r_m\phi_4q_4K_4 \tag{2-2-31}$$

The opportunity cost of these resources, for society as a whole, is

$$r_c(1-\phi_4)q_4K_4+r_m\phi_4q_4K_4 \tag{2-2-32}$$

There is a subsidy to local authority housing of:

$$(r_c-r_4)(1-\phi_4)q_4K_4. \tag{2-2-33}$$

This subsidy is in addition to any preferential tax treatment given local authority housing.

(2-2-30) in (2-2-29) reveals

$$(2\text{-}2\text{-}34) \quad P^*_{K_4} = \frac{q_4\{r_c(1-\phi_4)+(1-\beta_4 u_4)r_m\phi_4+(1-\gamma_4 u_4)m_4+(1-\varepsilon_4 u_4)t_4+(1-\zeta_4 u_4)\delta_4-(1-\Delta_4\lambda_4 u_4)\hat{\Theta}_4\} -R_4-q_4\{(r_c-r_4)(1-\phi_4)\}}{(1-\alpha_4 u_4)}$$

It is not obvious how the user cost of local authority housing should be interpreted. The problem arises because of the conceptual difficulty in distinguishing between the local authority (or authorities) and their employer, the Government. The attitude adopted here is to view the target rate of return on local authority housing as a Government decision. Any difference between rates of return obtainable elsewhere, and this target rate of return is an explicit subsidy to local authority housing (effectively, tax payers foot the bill). Hence, the rental price charged local authority tenants ($P^*_{K_4}$) is the actual user cost (from the local authority's point of view) of one unit of housing capital, gross of all taxes (if any) and subsidies, including the subsidy arising from an artificially low target rate of return.

Under present tax law in the United Kingdom, $u_4=R_4=0$. The individual here is the Government. Hence, from (2-2-34),

$$(2\text{-}2\text{-}35) \quad P^*_{K_4}=C_4=q_4\{r_4(1-\phi_4)+r_m\phi_4+m_4+\delta_4-\hat{\Theta}_4\},$$

where $t_4=0$, of course.

The user costs of owner-occupied, and rented, housing, under present United Kingdom tax law are:

For owner-occupied housing:

$$C_1=q_1\{(1-u_1)r_c(1-\phi_1)+(1-u_1)r_m\phi_1+m_1+t_1+\delta_1-\hat{\theta}_1\}, \tag{2-2-36}$$

which differs from the unit user costs for owner-occupiers under Australian, Canadian, and New Zealand tax law, by including a tax deduction for mortgage interest. For landlords

$$C_2=q_2\{r_c(1-\phi_2)+r_m\phi_2+m_2+t_2\}+\frac{q_2\{\delta_2-(1-\cdot 3\lambda_2)\hat{\theta}_2\}}{(1-u_2)}. \tag{2-2-37}$$

The subsidy to owner-occupied housing under United Kingdom tax legislation is

$$S=q_1(\frac{\bar{u}_1}{1-\bar{u}_1})\{(1-\bar{u}_1)r_c(1-\phi_1)+(1-\bar{u}_1)r_m\phi_1 +\delta_1-(1-\frac{\cdot 3\lambda_1}{\bar{u}_1})\hat{\theta}_1\}. \tag{2-2-38}$$

Since capital markets are assumed perfectly competitive, $r_c=r_m$. Hence, the unit subsidy is

$$S=q_1(\frac{\bar{u}_1}{1-\bar{u}_1})\{(1-\bar{u}_1)r_c+\delta_1-(1-\frac{\cdot 3\lambda_1}{\bar{u}_1})\hat{\theta}_1\}. \tag{2-2-39}$$

In addition, there is a subsidy to local authority housing. This subsidy is defined here as the difference between user costs if the target rate of interest on local authority housing were set equal to the social rate of opportunity cost (i.e., $r_4=r_c$) and local authority rentals were taxed as private rentals are presently taxed, and user costs under present law. This unit subsidy (denoted S(A)) is

$$S(A)=q_4\{(r_c-r_4)(1-\phi_4)+t_4+(\frac{\bar{u}_2}{1-\bar{u}_2})\delta_4-(\frac{\bar{u}_2}{1-\bar{u}_2})(1-\frac{\cdot 3\lambda_4}{\bar{u}_2})\hat{\theta}_4\} \tag{2-2-40}$$

This subsidy is positive (respectively, zero, negative) as

$$(2\text{-}2\text{-}41) \quad (r_c - r_4) \gtreqless \frac{1}{(1-\phi_4)} \left[\left[\frac{\bar{u}_2 - \cdot 3\lambda_4}{1-\bar{u}_2} \right] \hat{\theta}_4 - t_4 - \left[\frac{\bar{u}_2}{1-\bar{u}_2} \right] s_4 \right],$$

where it is assumed that $\phi_4 < 1$. Clearly, it is possible that local authority housing is subsidized relative to private rental housing even if the target rate of return on local authority housing equals the social rate of opportunity cost. This is because of the differential tax treatment of private, and local authority, rented housing.

The sign of the owner-occupier subsidy depends upon the relationship between λ_1 and $\bar{u}_1$:

If $\lambda_1 < 3 \cdot \dot{3}\bar{u}_1$,

$$S \gtreqless 0 \text{ as } r_0 - (\hat{\theta}_1 - \tilde{\theta}) \gtreqless r_c\{1 - \frac{(1-\bar{u}_1)\bar{u}_1}{(\bar{u}_1 - \cdot 3\lambda_1)}\} - \frac{\delta_1 \bar{u}_1}{(\bar{u}_1 - \cdot 3\lambda_1)}. \qquad 16.$$

If $\lambda_1 = 3 \cdot \dot{3}\bar{u}_1$,

$$S \gtreqless 0 \text{ as } \bar{u}_1 \gtreqless 0.$$

If $\lambda_1 > 3 \cdot \dot{3}\bar{u}_1$,

$$S \gtreqless 0 \text{ as } r_0 - (\hat{\theta}_1 - \tilde{\theta}) \lesseqgtr r_c\{1 - \frac{(1-\bar{u}_1)\bar{u}_1}{(\bar{u}_1 - \cdot 3\lambda_1)}\} - \frac{\delta_1 \bar{u}_1}{(\bar{u}_1 - \cdot 3\lambda_1)} \qquad 16.$$

A comparison of the unit subsidy in (2-2-32) with those derived for other countries, reveals that the owner-occupier subsidy under United Kingdom legislation is always larger than under Australian legislation, and is larger than under Canadian legislation if

$$\bar{u}\{(1-u)r_c\phi_1 + \delta_1\} > (\cdot 5u_1 - \cdot 3)\lambda_1\hat{\theta}_1.$$

The United Kingdom subsidy is larger than the first of the New Zealand subsidies derived above, and is larger than the second of the New Zealand subsidies if

$$q_1K_1(\frac{\bar{u}_1}{1-\bar{u}_1})\{(1-\bar{u}_1)r_c\phi_1+\delta_1+\frac{\cdot 3\lambda_1\hat{\theta}_1}{\bar{u}_1}\}>\min\{\tfrac{1}{2}r_mq_1K_1,1000\}.$$

There are two reasons why the United Kingdom subsidy might usually be larger than the owner-occupier subsidies in the other countries so far: The first is the taxation of capital gains realised by landlords (but not owner-occupiers); and the second is the tax deductibility of mortgage interest payments for owner-occupiers.

Differentiation of (2-2-32), with respect to $\bar{u}_1$, reveals:

(2-2-42) $$\frac{\partial S}{\partial \bar{u}_1}=q_1\{r_c+\frac{\delta_1-\hat{\theta}_1(1-\cdot 3\lambda_1)}{(1-\bar{u}_1)^2}\}\gtreqless 0 \text{ as } r_0+(\hat{\theta}_1-\tilde{\theta}) \gtreqless r_c\{1-\frac{(1-\bar{u}_1)^2}{(1-\cdot 3\lambda_1)}\}-\frac{\delta_1}{(1-\cdot 3\lambda_1)}\ .$$

The computations for the United Kingdom case, appearing in Table 2-2-1, assume that $\lambda_1=1$; i.e., all capital gains are realised as they accrue. But as (2-2-32) reveals:

(2-2-43) $$\frac{\partial S}{\partial \lambda_1}=\frac{3\hat{\theta}_1q_1}{(1-\bar{u}_1)}\ \geqq 0 \text{ as } \hat{\theta}_1 \geqq 0.$$

Hence, the assumption of $\lambda_1=1$ tends to overstate the actual size of the owner-occupier subsidy. As has already been seen, the same is true under Canadian tax legislation.

With $\lambda_1=1$, the critical real interest rate is:

$$\text{for } \bar{u}_1 \neq \cdot 3, \bar{r}=\frac{r_c\{\bar{u}_1-\cdot 3-(1-u_1)u_1\}-\delta_1u_1}{\bar{u}_1-\cdot 3}+(\hat{\theta}_1-\tilde{\theta})$$

The significance of this critical real interest rate is:

(i) If $0<\bar{u}_1<\cdot 3$, $S \gtreqless 0$ as $r_0 \gtreqless \bar{r}$.

(ii) If $\cdot 3<\bar{u}_1<1$, $S \gtreqless 0$ as $r_0 \gtreqless \bar{r}$.

(iii) If $\bar{u}_1=\cdot 3$, $S>0$, $\forall r_0$.

The critical real interest rate, for different values of $\bar{u}_1$, is presented in Table 2-2-1.

(2-2-32) can be written, in terms of the real interest rate, as:

$$(2\text{-}2\text{-}44)\quad S=q_1\left(\frac{\bar{u}_1}{1-\bar{u}_1}\right)\left\{r_c\frac{\bar{u}_1(1-\bar{u}_1)-(\bar{u}_1-\cdot 3\lambda_1)}{\bar{u}_1}\right\}+\delta_1+r_0\left[\frac{\bar{u}_1-\cdot 3\lambda_1}{\bar{u}_1}\right]$$
$$-(\hat{\Theta}_1-\tilde{\Theta})\left[\frac{\bar{u}_1-\cdot 3\lambda_1}{\bar{u}_1}\right]$$

from which,

$$(2\text{-}2\text{-}45)\quad \frac{\partial S}{\partial r_0} = q_1\frac{(\bar{u}_1-\cdot 3\lambda_1)}{(1-\bar{u}_1)} \gtreqless 0 \text{ as } \bar{u}_1 \gtreqless \cdot 3\lambda_1 .$$

(2-2-45) is interesting. For every other country considered above, this partial derivative is unambiguously positive: In each of those countries, the subsidy to owner-occupied housing increases with increases in the real rate of interest. But under United Kingdom legislation, the same is true only if $u_1>\cdot 3\lambda_1$. In Table 2-2-1 it has been assumed that all capital gains are realised as they accrue. Under this assumption, the owner-occupier subsidy increases with increases in the real rate of interest only for individuals with a marginal tax rate in excess of 30 percent, the statutory tax rate on realised capital gains.

Without exception, the United Kingdom subsidies computed in Table 2-2-1 exceed those computed for Australia, Canada, and New Zealand. The degree of vertical inequity associated with the subsidy is also larger under United Kingdom legislation than under legislation operating in Australia, Canada, and New Zealand.

The analysis presented here also permits an examination of the relative treatments of owner-occupiers and local authority tenants.[18] Hence, suppose $q_1=q_4$, $\delta_1=\delta_4$, $m_1=m_4$. Then a comparison of (2-2-35) and (2-2-36) reveals that the cost of housing is greater to an owner-occupier than to a local authority tenant if

$$(2\text{-}2\text{-}46) \qquad (1-\bar{u}_1)\{r_c(1-\phi_1)+r_m\phi_1\}+t_1-\hat{\Theta}_1>r_4(1-\phi_4)-\hat{\Theta}_4$$ [19]

The right-hand side of (2-2-46) is the target rate of return to local authority housing, excluding capital gains. It is not clear that the left-hand-side exceeds this target rate of return, under all circumstances. The relative cost of owner-occupied housing depends upon the individual marginal tax rate, the share of equity in housing, the mortgage and opportunity rates of interest, rates and local property taxes, and rates of capital gain on housing. Table 2-2-2 illustrates this dependence on individual circumstance. The table shows the difference $(1-\bar{u}_1)\{r_c(1-\phi_1)+r_m\phi_1\}+t_1-\hat{\Theta}_1 -\{r_4(1-\phi_4)-\hat{\Theta}_4\}$, under the variety of different circumstances considered by King and Atkinson (1980, p.10). From Table 2 of King and Atkinson, a value of

$$\{r_4(1-\phi_4)-\hat{\Theta}_4\} = .0145$$

has been selected. A mortgage interest rate of 12 percent,

TABLE 2-2-2: The User Costs of Owner-Occupation Versus the Costs of Local Authority Tenure; Some Illustrative Calculations of Differences in Rates of User Cost; United Kingdom.

(Percent per annum)[1.]

Debt and Interest	Marginal Tax Rate of Owner-Occupier ($\bar{u}_1$)				
	.25	.30	.40	.50	.60
A: $\phi_1 = .8$					
$r_c = .09$	.001	-.0047	-.0161	-.0275	-.0389
.12	.0055	-.0005	-.0125	-.0245	-.0365
.15	.01	.0037	-.0089	-.0215	-.0341
B: $\phi_1 = .2$					
$r_c = .09$	-.0125	-.0173	-.0269	-.0365	-.0461
.12	.0055	-.0005	-.0125	-.0245	-.0365
.15	.0235	.0163	.0019	-.0125	-.0269

Source: Variety of circumstances is from King and Atkinson (1980, p.10), excluding cases where the value of mortgage exceeds £25,000 ceiling for mortgage interest deductibility.

Other Data: $t_1 = .01$; $r_m = .12$; $\hat{\theta}_1 = .08$; $r_4(1-\phi_4)-\hat{\theta}_4 = .0145$.

1. A positive figure indicates that owner-occupiers face larger costs than local authority tenants. The figure is the difference in the (percentage) rates of user cost.

and an annual rate of increase of house prices of 8 percent, have been assumed throughout. In addition, a property tax rate of 1 percent has been used.

According to the housing circumstances illustrated in Table 2-2-2, owner-occupiers in the United Kingdom typically face smaller housing costs than do local authority tenants. Only for high rates of opportunity cost, and low marginal tax rates, do owner-occupiers pay more than local authority tenants. Of course, provided $r_c \neq r_m$, the relative position of owner-occupiers depends upon mortgage debt, but the dependence is not significant: For owner-occupiers with marginal tax rates of 30 percent or more, local authority housing is cheaper only if the rate of opportunity cost is 15 percent, and it is never cheaper for owner-occupiers with marginal tax rates of 50 percent or more.

(e) United States of America

According to United States tax legislation effective as at November, 1978, imputed rentals on owner-occupied housing are not taxed. The tax law distinguishes between "short-term" capital gains (accruing on property held for less than twelve months), and "long-term" capital gains. "Short-term" realised capital gains are taxed at the normal income tax rate. There are two methods used to calculate tax liability on "long-term" realised capital gains. Under the first method, one-half of the realised capital gains are added to the individual's other income, and the sum is taxed at the normal rates of tax. According to the second method (referred to as the "alternative tax"), special rates of tax apply: If the "long-term" capital gain is less than \$50,000 it is taxed at a rate of 25 percent; if the gain exceeds \$50,000, the first \$50,000 is taxed at a rate of 25 percent, and tax on anything over that is calculated as the difference between ordinary tax on other income plus half the capital gains, and ordinary tax on other income plus \$25,000. The individual is permitted to choose the method which minimizes his total tax liability.

As in the United Kingdom, individuals can escape the taxation of capital gains[20.] by reinvesting those gains in similar assets.

Property taxes and mortgage-interest payments are tax deductible for both landlords and owner-occupiers. But depreciation allowances only apply to property held for the purpose of generating actual income, as (of course) do deductions for the costs of repairs, maintenance, and casualty insurance premiums.

Supposing that an individual is taxed on long-term capital gains according to the first method:[21.]

$$(2\text{-}2\text{-}47)\quad C_1=q_1\{(1-u_1)r_c(1-\phi_1)+(1-u_1)r_m\phi_1+(1-u_1)t_1+m_1$$
$$+\delta_1-(1-\tfrac{1}{2}u_1)\lambda_1\hat{\theta}_1\}$$

$$(2\text{-}2\text{-}48)\quad C_2=q_2\{r_c(1-\phi_2)+r_m\phi_2+m_2+t_2+\delta_2\}-q_2\,\frac{(1-\tfrac{1}{2}u_2)}{(1-u_2)}\lambda_2\hat{\theta}_2$$

The unit subsidy on owner-occupied housing under United States tax law is:

$$(2\text{-}2\text{-}49) \qquad S=\bar{u}_1 q_1\{r_c(1-\phi_1)+r_m\phi_1+t_1\}-\lambda_1\bar{u}_1\hat{\theta}_1 q_1\frac{(1-\frac{1}{2}\bar{u}_1)}{(1-\bar{u}_1)}$$

Given perfectly competitive capital markets, this subsidy is

$$(2\text{-}2\text{-}50) \qquad S=\bar{u}_1 q_1(r_c+t_1)-\lambda_1\bar{u}_1\hat{\theta}_1 q_1\frac{(1-\frac{1}{2}\bar{u}_1)}{(1-\bar{u}_1)}$$

$$\gtreqless 0 \text{ as } r_0-(\hat{\theta}_1-\tilde{\theta}) \gtreqless \frac{r_c[\lambda_1(1-\frac{1}{2}\bar{u}_1)-(1-\bar{u}_1)]+t_1(1-\bar{u}_1)}{\lambda_1(1-\frac{1}{2}\bar{u}_1)}.$$

If capital gains are ignored, (2-2-50) is the unit subsidy employed in Laidler's (1969) study.[22.] Examination of (2-2-50) reveals:

$$(2\text{-}2\text{-}51) \qquad \frac{\partial S}{\partial\lambda_1} = -\bar{u}_1\hat{\theta}_1 q_1\frac{(1-\frac{1}{2}\bar{u}_1)}{(1-\bar{u}_1)} \lesseqgtr 0 \text{ as } \hat{\theta}_1 \gtreqless 0.$$

This result is in marked contrast to the corresponding results obtained for Canada and the United Kingdom, which also tax (some) capital gains. The opposite sign in this case arises because of the taxation of capital gains on owner-occupied housing. Since the value of λ_1 is subject to choice, there is (ceteris paribus) less incentive for owner-occupiers to realise capital gains under United States tax legislation than under Australian, Canadian, New Zealand, or United Kingdom legislation. This point is returned to in Section 2.3.

To test for vertical inequity, differentiate (2-2-51), with respect to $\bar{u}_1$, to obtain:

$$\text{(2-2-52)}\quad \frac{\partial S}{\partial \bar{u}_1} = q_1(r_c+t_1)-\lambda_1\hat{\theta}_1 q_1\left[\frac{(1-\bar{u}_1)+\frac{1}{2}\bar{u}_1^{\,2}}{(1-\bar{u}_1)^2}\right] \gtreqless 0$$

$$\text{as } r_0-(\hat{\theta}_1-\tilde{\theta}) \gtreqless r_c-\frac{(r_c+t_1)(1-\bar{u}_1)^2}{\lambda_1[(1-\bar{u}_1)+\frac{1}{2}\bar{u}_1^{\,2}]}\,.$$

The subsidy under United States legislation is larger than the subsidy under United Kingdom legislation if

$$(1-\bar{u}_1)t_1+\hat{\theta}_1\left(\frac{\bar{u}_1-.3\lambda_1-\lambda_1\bar{u}_1+\frac{1}{2}\lambda_1\bar{u}_1^{\,2}}{\bar{u}_1}\right)<\delta_1,$$

where it has been assumed (for simplicity) that the individual realises the same percentage of accrued capital gains under both tax systems. The differences between the United States and United Kingdom subsidies arise because of: The tax deductibility of rates and local property taxes for both owner-occupiers and landlords under United States legislation, and for landlords only, under United Kingdom legislation; depreciation allowances for rented property under United States, but not United Kingdom, legislation; and the taxation of capital gains realised by both landlords and owner-occupiers under United States legislation, but by landlords only, under United Kingdom legislation.

Some illustrative calculations for the United States case are presented in Table 2-2-1. It has been assumed that $\lambda_1=1$. As (2-2-51) reveals, this understates actual subsidies in the United States. In addition it is assumed that rates and local property taxes are 1.5 percent of house value (i.e., $t_1 = \cdot 015.$)[23.] The subsidies computed under United States tax legislation are smaller than the subsidies computed under United Kingdom tax legislation, but are larger than the subsidies computed for other countries (except for the cases $\bar{r} = \cdot 15$ and $\bar{u}_1 = \cdot 6$ or $\cdot 7$, in which case, subsidies are larger under Australian legislation). The vertical inequity associated with the owner-occupier subsidy in the United States is much the same as in Australia.

(f) <u>West Germany</u>

According to current West German tax legislation, imputed rentals on owner-occupied housing are subject to income tax. The assessment of income tax liability depends upon whether the residence is occupied exclusively by the owner, or the owner occupies one apartment only. "Letting" an apartment free of charge is viewed as owner-occupied use, and is taxable. If the owner occupies one apartment or flat, which is only a part of the housing owned, the imputed rental is set equal to average rental for an apartment of comparable type, location, and fittings. All expenses (including mortgage interest payments, real estate tax, wealth tax, repairs and maintenance, depreciation) are deductible in assessing net taxable income. For one-family houses, or ownership apartments, the imputed monthly rental is fixed at one percent of house value, assessed by the Department of Finance. No further deductions for maintenance, depreciation, and so on, are allowed, except mortgage interest up to the amount of the imputed rental.

There is no capital gains tax on personal or private wealth held for more than two years. In other cases, the capital gains are taxed as part of all other income. All real estate is subject to real estate tax. In addition, there is a wealth tax which strikes real estate as part of private net wealth.

Ignoring the wealth tax, the West German tax provisions imply

$$\text{(2-2-53)} \qquad C_2 = q_2\{r_c(1-\phi_2)+r_m\phi_2+m_2+t_2+\delta_2 - \frac{\hat{\theta}_2 q_2}{(1-u_2)},$$

where it has been assumed that residential property is held for more than two years, and that rental property forms part of the landlord's private net wealth. If the representative owner-occupier occupies a one-family residence, the annual user cost is

$$\text{(2-2-54)} \quad C_1 = q_1\{(1-u_1)r_c(1-\phi_1)+r_m\phi_1+m_1+t_1+\delta_1-\hat{\theta}_1\}+\Pi_1(1)$$

<u>where</u>: $\Pi_1(1) = \max\{u_1(.12-r_m\phi_1)q_1, 0\}$

If the representative owner-occupier occupies one apartment only in a multi-apartment dwelling, tax liability is

$$\text{(2-2-55)} \quad \Pi_1(2) = u_1\{P^*_{K_2}-q_1(r_m\phi_1+m_1+t_1+\delta_1)\}$$

$$= u_1q_1\{r_c(1-\phi_1)-\hat{\theta}_1/(1-u_2)\},$$

on assuming $r_m = r_c$, $q_1 = q_2$, $m_1 = m_2$, $t_1 = t_2$, $\delta_1 = \delta_2$, and $\hat{\theta}_1 = \hat{\theta}_2$. (2-2-55) in the place of $\Pi_1(1)$ in (2-2-54) reveals that in this second case,

$$(2\text{-}2\text{-}56) \quad C_1 = q_1\{r_c(1-\phi_1)+r_m\phi_1+m_1+t_1+\delta_1-\left[\frac{1-u_2+u_1}{1-u_2}\right]\hat{\theta}_1\}$$

In the first case, the subsidy to owner-occupied housing is (assuming $r_m\phi_1 < .12$)

$$(2\text{-}2\text{-}57) \quad S(1) = \bar{u}_1 q_1\{r_c-.12-\frac{\hat{\theta}_1}{1-\bar{u}_1}\} \gtreqless 0 \text{ as } r_0-(\hat{\theta}_1-\tilde{\theta})$$

$$\gtreqless .12(1-\bar{u}_1)+\bar{u}_1 r_c$$

The critical real interest rate is

$$\bar{r} = .12(1-\bar{u}_1)+\bar{u}_1 r_c+(\hat{\theta}_1-\tilde{\theta})$$

Testing for vertical inequity reveals:

$$(2\text{-}2\text{-}58) \quad \frac{\partial S(1)}{\partial \bar{u}_1} = q_1\{r_c-.12-\hat{\theta}_1\left[\frac{1-\bar{u}_1+\bar{u}_1{}^2}{(1-\bar{u}_1)^2}\right]\} \gtreqless 0 \text{ as } r_0-(\hat{\theta}_1-\tilde{\theta})$$

$$\gtreqless .12+\frac{\hat{\theta}_1\bar{u}_1}{(1-\bar{u}_1)^2}$$

In the second case, the subsidy to owner-occupied housing is

$$(2\text{-}2\text{-}59) \quad S(2) = -\hat{\theta}_1 q_1\{\frac{\bar{u}_1(\bar{u}_1-\bar{u}_2)}{(1-\bar{u}_1)(1-\bar{u}_2)}\} \gtreqless 0 \text{ as } \bar{u}_2 \gtreqless \bar{u}_1$$

To test for vertical inequity, note that

$$(2\text{-}2\text{-}60) \quad \frac{\partial S(2)}{\partial \bar{u}_1} = -\hat{\theta}_1 q_1\{\frac{\bar{u}_1(1-\bar{u}_1)+(\bar{u}_1-\bar{u}_2)}{(1-\bar{u}_1)(1-\bar{u}_2)}\} \gtreqless 0 \text{ as } u_1 \lesseqgtr \frac{(\bar{u}_1{}^2+\bar{u}_2)}{2}$$

Table 2-2-1 presents illustrative calculations of the size of the owner-occupier subsidy under West German tax legislation, assuming that the representative owner-occupier occupies a single-family dwelling. At any real rate of interest less than 12 percent, the subsidy is negative. It is clear that West German tax legislation implies smaller subsidies to owner-occupied housing than legislation in any of the five other Western countries considered in this Chapter.

2.3 COMPARATIVE PARTIAL EQUILIBRIUM STATICS OF HOUSING POLICY AND "USER COSTS"

This Section examines the implications of changes in tax policy instruments for the user costs of housing, both owner-occupied and rented,[24.] and for the subsidy to owner-occupied housing. In keeping with the partial equilibrium nature of the analysis, it is assumed that the gross rate of opportunity cost on equity is exogenous. Section 2.2 identified nine tax policy instruments in the user cost expression derived in Section 2.1. These instruments are: u_i, the individual tax rate; α_i, the proportion of gross rental income subject to tax at the rate u_i; β_i, the proportion of interest payments on debt which are tax deductible; γ_i, the proportion of the costs of repairs, maintenance, casualty insurance premiums, which are tax deductible; ε_i, the proportion of rates and local property taxes which are (income-) tax deductible; ζ_i, the proportion of the economic value of depreciation which is tax deductible; Δ_i, the proportion of realised capital gains subject to income tax; t_i, rates and local property taxes as a proportion of capital value; and R_i, tax rebates on one unit of housing capital. In addition, governments have some direct control over r_m.

The following partial derivatives can be derived from (2-2-1). They show the responsiveness of the user cost of housing to changes in each of the tax policy instruments, and in r_m.[25.]

$$\text{(2-3-1)} \qquad \frac{\partial C_i}{\partial \alpha_i} = C_i\left(\frac{u_i}{1-\alpha_i u_i}\right) \gtreqless 0 \text{ as } C_i \gtreqless 0.$$

$$\text{(2-3-2)} \qquad \frac{\partial C_i}{\partial u_i} = \frac{q_i\{(\alpha_i-1)r_c(1-\phi_i)+(\alpha_i-\beta_i)r_m\phi_i+(\alpha_i-\gamma_i)m_i+(\alpha_i-\varepsilon_i)t_i+(\alpha_i-\zeta_i)\delta_i-(\alpha_i-\Delta_i\lambda_i)\hat{\Theta}_i\}-\alpha_i R_i}{(1-\alpha_i u_i)^2}$$

$$\text{(2-3-3)} \qquad \frac{\partial C_i}{\partial \beta_i} = -q_i r_m \phi_i\left(\frac{u_i}{1-\alpha_i u_i}\right) \lesseqgtr 0 \text{ as } \phi_i \gtreqless 0.$$

$$\text{(2-3-4)} \qquad \frac{\partial C_i}{\partial \gamma_i} = -q_i m_i\left(\frac{u_i}{1-\alpha_i u_i}\right) \lesseqgtr 0 \text{ as } m_i \gtreqless 0.$$

$$\text{(2-3-5)} \qquad \frac{\partial C_i}{\partial \varepsilon_i} = -q_i t_i\left(\frac{u_i}{1-\alpha_i u_i}\right) \lesseqgtr 0 \text{ as } t_i \gtreqless 0.$$

$$\text{(2-3-6)} \qquad \frac{\partial C_i}{\partial \zeta_i} = -q_i \delta_i\left(\frac{u_i}{1-\alpha_i u_i}\right) \lesseqgtr 0 \text{ as } \delta_i \gtreqless 0.$$

$$\text{(2-3-7)} \qquad \frac{\partial C_i}{\partial \Delta_i} = q_i \lambda_i \hat{\Theta}_i\left(\frac{u_i}{1-\alpha_i u_i}\right) \gtreqless 0 \text{ as } \lambda_i\hat{\Theta}_i \gtreqless 0.$$

$$\text{(2-3-8)} \qquad \frac{\partial C_i}{\partial t_i} = q_i\frac{(1-u_i\varepsilon_i)}{(1-\alpha_i u_i)} > 0.$$

$$\text{(2-3-9)} \qquad \frac{\partial C_i}{\partial R_i} = \frac{1}{(1-\alpha_i u_i)} > 0.$$

$$\text{(2-3-10)} \qquad \frac{\partial C_i}{\partial r_m} = \frac{q_i\phi_i(1-u_i\beta_i)}{(1-\alpha_i u_i)} \gtreqless 0 \text{ as } \phi_i \gtreqless 0.$$

(2-3-3) through (2-3-10) have obvious interpretations. (2-3-1) simply says that taxing gross rentals increases positive user costs, and reduces negative user costs. (2-3-2) is of especial interest: The sign of $\partial C_i/\partial u_i$ is ambiguous. However, consider the following important case: Suppose that all gross rentals are subject to taxation at the rate u_i, but that costs of mortgage interest, repairs, maintenance, and casualty insurance premiums, rates and local property taxes, are fully tax deductible. In addition, suppose that capital gains are taxed on an accruals basis, and that there are no tax rebates. Together, these assumptions imply $\alpha_i=\beta_i=\gamma_i=\varepsilon_i=\lambda_i\Delta_i=1, R_i=0$. (2-3-2) is

$$\text{(2-3-11)} \quad \frac{\partial C_i}{\partial u_i} = q_i \delta_i \frac{(1-\zeta_i)}{(1-u_i)^2} \; .$$

If there is full tax deductibility of economic depreciation, so that $\zeta_i=1$, then $\partial C_i/\partial u_i=0$; i.e., the rate of "user cost" is insensitive to changes in the tax rate. If depreciation provisions for taxation purposes are even more generous, so that $\zeta_i>1$, then $\partial C_i/\partial u_i$ is clearly negative. Results like these were first discovered by Samuelson (1964). Since then, similar results have appeared in a number of places, including Hall and Jorgenson (1969).

There is an enormous literature which is concerned with the proper sign to attach to $\partial C_i/\partial u_i$ in the case of the United States corporate income tax. Leading contributions to the debate include Hall and Jorgenson (1967), (1969), (1971), Coen (1968), (1975), Eisner and Nadiri (1968), Eisner (1969), (1970), (1973). All of these papers are partial equilibrium analyses. Not surprisingly, then, the most contentious issue in this literature relates to the extent to which the net rate of return on corporate capital is affected by changes in the corporate tax rate. This issues is equivalent to the question of the shifting of the corporation income tax. Each of these issues is examined in Chapter 3, where it is argued that these sorts of questions can only properly be analysed in general equilibrium models. In the present analysis, these issues are ignored by the assumption that r_c is independent of u_i. This permits the partial derivative, $\partial C_i/\partial u_i$, to be evaluated for each of the six Western countries examined earlier. In the case of Australia:

$$\frac{\partial C_1}{\partial u_1} = -q_1 r_c (1-\phi_1) \lesseqgtr 0 \text{ as } \phi_1 \lesseqgtr 1$$

$$\frac{\partial C_2}{\partial u_2} = \frac{q_2(\delta_2-\hat{\theta}_2)}{(1-u_2)^2} \gtreqless 0 \text{ as } \delta_2 \gtreqless \hat{\theta}_2$$

Hence, under Australian tax legislation, the treatment of owner-occupied housing favours those on higher marginal tax rates (higher incomes) relative to those on lower marginal tax rates. i.e., the taxation of owner-occupied housing reduces the progressivity of the individual income tax. The condition on rented housing is interesting. Capital gains are essentially tax free, and depreciation allowances are not tax deductible. Richer landlords face smaller investment costs if the expected rate of capital gain on housing exceeds the rate of economic depreciation.

In the case of Canada:

$$\frac{\partial C_1}{\partial u_1} = -q_1 r_c (1-\phi_1) \lesseqgtr 0 \text{ as } \phi_1 \lesseqgtr 1.$$

$$\frac{\partial C_2}{\partial u_2} = \frac{-\frac{1}{2}\lambda_2 q_2 \hat{\theta}_2}{(1-u_2)^2} \lesseqgtr 0 \text{ as } \lambda_2\hat{\theta}_2 \gtreqless 0.$$

The condition on owner-occupied housing is the same as under Australian tax legislation. The condition on rented housing arises because one-half of capital gains are tax free. It is interesting that the Canadian tax treatment of landlords (which taxes one-half of capital gains but allows depreciation as a tax deduction) might actually produce a greater degree of vertical inequity than the Australian tax treatment (which does not tax capital gains, but which does not permit deductions for depreciation, either). A comparison of the $\partial C_2/\partial u_2$ expressions obtained for Australia and Canada reveals that what is required is $\delta_2 > \hat{\theta}_2(1-\frac{1}{2}\lambda_2)$.

In the case of New Zealand:

$$\frac{\partial C_1}{\partial u_1} = -q_1 r_c(1-\phi_1) \lesseqqgtr 0 \text{ as } \phi_1 \lesseqqgtr 1,$$ [26].

which is the same as for Australia and Canada; and

$$\frac{\partial C_2}{\partial u_2} = \frac{-q_2\hat{\theta}_2}{(1-u_2)^2} \lesseqqgtr 0 \text{ as } \hat{\theta}_2 \gtreqqless 0.$$

Again, the condition on rented housing arises because of the failure to tax capital gains.

In the case of the United Kingdom:

$$\frac{\partial C_1}{\partial u_1} = -q_1\{r_c(1-\phi_1)+r_m\phi_1\} < 0$$

$$\frac{\partial C_2}{\partial u_2} = \frac{q_2\{\delta_2-(1-\cdot 3\lambda_2)\hat{\theta}_2\}}{(1-u_2)^2} \gtreqqless 0 \text{ as } \delta_2 \gtreqqless (1-\cdot 3\lambda_2)\hat{\theta}_2$$

Hence, United Kingdom tax legislation favours owner-occupiers on higher incomes over those on lower incomes; while the same is true for landlords only if the rate of economic depreciation on rented housing is less than $(100-30\lambda_2)$ percent of the expected rate of capital gain.

In the case of the United States of America:

$$\frac{\partial C_1}{\partial u_1} = -q_1\{r_c(1-\phi_1)+r_m\phi_1+t_1-\tfrac{1}{2}\lambda_1\hat{\theta}_1\}$$

$$\frac{\partial C_2}{\partial u_2} = \frac{-\tfrac{1}{2}q_2\lambda_2\hat{\theta}_2}{(1-u_2)^2} \leqq 0 \text{ as } \lambda_2\hat{\theta}_2 \geqq 0,$$

where it is assumed that realised capital gains are taxed as long-term gains under the first method described in Section 2.2. The condition on rented housing is the same as for Canada. In the case of owner-occupied housing, United States tax legislation favours those on higher incomes against lower income earners provided the sum of the mortgage and opportunity interest costs and local property taxes exceeds fifty percent of taxable capital gains. It is almost impossible to conceive of this not being the case. Indeed, the United States income tax encourages owner-occupiers never to realise capital gains, and so to avoid paying capital gains taxes indefinitely. When there is a high rate of inflation, and owner-occupiers are enjoying high rates of capital gain on their housing, there is an incentive to borrow against the value of those capital gains at a cost of $(1-\bar{u}_1)r_m dq_1$ per year,[27.] and to consume the value of the gains, rather than to realise the capital gains and so pay $\tfrac{1}{2}\bar{u}_1 dq_1$ in capital gains tax. To appreciate the magnitude of this incentive, consider the investment alternatives open to an owner-occupier who finds that his house has increased in value by an amount dq_1, and is likely to continue to increase in value at a rate of $\hat{\theta}_1$ per annum. The individual could realise the capital gains, paying $\frac{1}{2}\bar{u}_1 dq_1$ in capital gains taxes, and invest the remainder, $(1-\frac{1}{2}\bar{u}_1)dq_1$, in an alternative investment for an annual net return of $(1-\bar{u}_1)r_c(1-\frac{1}{2}\bar{u}_1)dq_1$. Alternatively, the individual could choose not to realise the capital gains, but instead, to borrow against them at a cost of $(1-\bar{u}_1)r_m dq_1$ per annum; with the dq_1 still invested in his house, he continues to accrue capital gains of $\hat{\theta}_1 dq_1$ on that sum, and he earns an after-tax return of $(1-\bar{u}_1)r_c dq_1$ by investing the sum that he has borrowed in an alternative investment. In this second case, the annual net return on the capital gains (dq_1) is $(1-\frac{1}{2}\bar{u}_1)\hat{\theta}_1 dq_1+(1-\bar{u}_1)dq_1\{r_c-r_m\}$, if the individual realises capital gains of $\hat{\theta}_1 dq_1$ at the end of the first year. If $r_c=r_m$ (which is realistic) the individual earns a higher net return in the second case if $(1-\frac{1}{2}\bar{u}_1)\hat{\theta}_1 dq_1>(1-\bar{u}_1)r_c(1-\frac{1}{2}\bar{u}_1)dq_1$; i.e., if $\hat{\theta}_1>(1-\bar{u}_1)r_c$. But if this condition holds, then the individual would do even better to borrow against the additional capital gains $\hat{\theta}_1 dq_1$ and realise capital gains of $(\hat{\theta}_1+\hat{\theta}_1^{\,2})dq_1$ at the end of the second year; or even better, to borrow against the capital gains $(\hat{\theta}_1+\hat{\theta}_1^{\,2})dq_1$ as well, and realise capital gains of $(\hat{\theta}_1+\hat{\theta}_1^{\,2}+\hat{\theta}_1^{\,3})dq_1$ at the end of the third year; and so on. Hence, the individual earns a higher net return by never realising capital gains, but by continually borrowing against them as they accrue.

It is easy to see that if the government provides mortgage finance at subsidized rates of interest, $r_m < r_c$, the incentives to never realise capital gains are even larger.

In the case of West Germany:

$$\frac{\partial C_1}{\partial u_1} = .12 - r_c \gtreqless 0 \text{ as } .12 \gtreqless r_c$$

$$\frac{\partial C_2}{\partial u_2} = \frac{-\hat{\Theta}_2 q_2}{(1-u_2)^2} \lesseqgtr 0 \text{ as } \hat{\Theta}_2 \gtreqless 0.$$

The condition on owner-occupied housing applies to owner-occupiers of single-family dwellings. The present tax treatment of this class of owner-occupiers discriminates against low income earners only if the nominal rate of interest exceeds 12 percent per annum. If the rate of interest is equal to 12 percent per annum, there is no vertical inequity associated with present tax law. The condition on rented housing is similar to those derived for other countries. For an occupier of one apartment of a multi-apartment dwelling, owned by the occupier:

$$\frac{\partial C_1}{\partial u_1} = -\hat{\Theta}_1 q_1 \lesseqgtr 0 \text{ as } \hat{\Theta}_1 \gtreqless 0.$$

This is similar to the condition for landlords, which is not surprising.

In each of Australia, Canada, New Zealand, the United Kingdom, and the United States of America, the taxation of owner-occupied housing reduces the user costs of home ownership for high income owner-occupiers relative to low income owner-occupiers. It is interesting that housing policies designed to encourage home ownership should have this effect.[28.]

This Section has explored the implications of tax policy disturbances for the user costs of home ownership for individual investors. The remainder of this Section employs the user cost concept in a diagrammatic exposition of the various partial equilibrium models of housing policy. In these analyses, the endogenous component of user costs is q_i, the price of housing stock. In view of this, it is convenient to define the "rate of user cost" (denoted c_i):

$$c_i \equiv \frac{C_i}{q_i} \; ; \quad c_2(1) \equiv \frac{C_2(1)}{q_1}.$$

An examination of (2-2-1) reveals that this "rate of user cost" is composed only of exogenous variables and government policy instruments (provided R_i is ignored): In the present analyses, c_i changes in response to changes in tax policy instruments, only.

In Section 2.1, which derived the expression for the user cost of housing capital, it was noted that, with respect to the individual decision-making of an individual landlord, the optimal stock of housing is indeterminate. Since the aggregate demand curves for owner-occupied and rented housing services can (realistically) be assumed to be downward sloping, however, industry output for both owner-occupied and rented housing is determinate. At the industry level, $P_K^*(s)$ is endogenous. The aggregate investment demand curves for rented and owner-occupied housing stock are derived from the aggregate consumption demand curves for housing services. The aggregate investment demand for rented housing is negatively related to the "user cost" of rented housing facing a representative landlord: Beginning from an initial position satisfying the optimality condition (2-1-29) for the representative individual, a reduction in the unit user cost of rented housing encourages each landlord to accumulate additional units of housing (at an infinitely rapid rate); the larger stock of housing made available for renting will be accepted by renters only if the gross rental price $P_K^*(s)$ falls. Eventually, $P_K^*(s)$ falls to equality with the new unit user cost. But when this happens, landlords will cease to increase their stocks of housing. The aggregate investment demand for owner-occupied housing is negatively related to the user costs of owner-occupied housing for the same reason.

In the case of owner-occupied housing, the aggregate investment demand curve shows the quantity of (number of units of) housing stock owner-occupiers are willing to invest in, given different unit rates of "user cost"; equivalently, it shows the maximum annual cost owner-occupiers are willing to pay for different quantities of housing held as an investment. The aggregate investment demand curve for rented housing has a similar interpretation.

The issue of the vertical inequity associated with housing policy has already been examined.[29.] The present partial equilibrium analysis extends the previous discussion of horizontal inequity in housing policy, and examines the other issues in housing policy; specifically, the incidence and efficiency aspects of the taxation of housing.

According to the definition employed in Section 2.2, there is no subsidy to owner-occupied housing if owner-occupiers are taxed in the same way as landlords. The effect of the introduction of a subsidy is to reduce the user cost associated with investment in any particular stock of owner-occupied housing, at least initially.[30.] Hence, for the representative owner-occupier, the user costs of investing in a house with a capital value of q_1 is not $C_2(1)=c_2(1)q_1$ (as it would be if there were no subsidy, but is $C_1=c_1q_1$. The "rate of subsidy" (denoted s) might be defined to be the unit subsidy, S, expressed as a percentage of unit user costs before the subsidy:

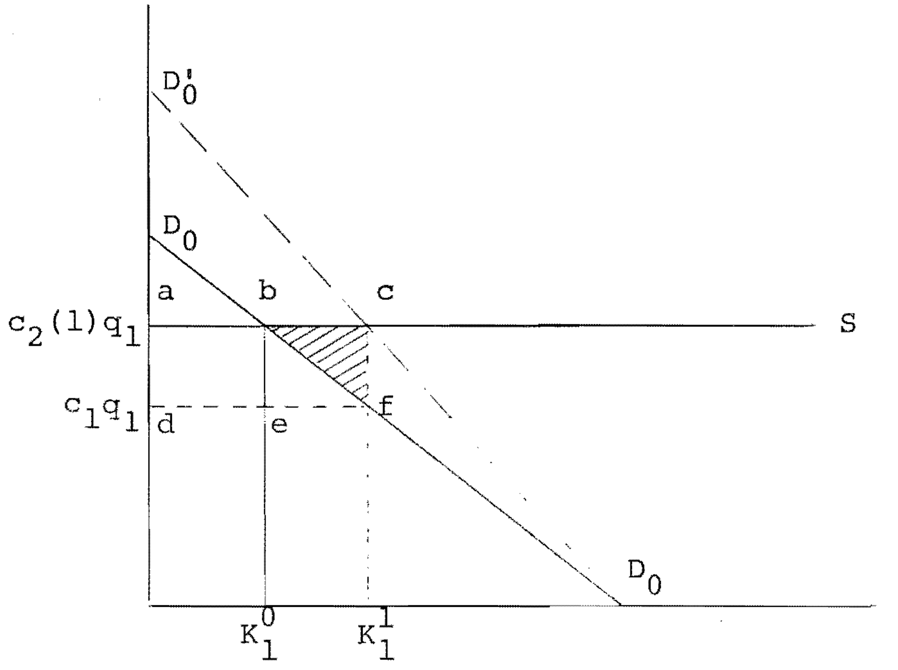
$$s \equiv S/C_2(1) = S/c_2(1)q_1.$$

The comparative static implications of the subsidy depend upon the assumptions made with respect to the supply of housing. Laidler (1969) and Reece (1975) assume that owner-occupied housing is supplied perfectly elastically. Figure 2-3-1(a) illustrates the impact of the owner-occupier subsidy in this case. Before the subsidy, the aggregate investment demand curve of owner-occupiers for housing is D_0D_0. Housing is supplied perfectly elastically at an annual cost of $c_2(1)q_1$. The effect of the subsidy is to increase effective (seller-perceived) demand: Owner-occupiers are prepared to pay more for each unit of housing since some of what they pay is reimbursed by the government. The extra amount owner-occupiers are prepared to pay is the amount of the unit subsidy (S). The new effective demand curve is $D_0'D_0$. The vertical distance between $D_0'D_0$ and D_0D_0 is S. The effect of the subsidy is to cause the stock of owner-occupied housing to increase from K_1^0 to K_1^1. The stock price of housing is unaffected. The area abed in Figure 2-3-1(a) shows the reduction in the annual costs of owner-occupation of the initial housing stock. The deadweight loss associated with the subsidy is bcf. This is the difference between the cost of the subsidy to the government, acfd, and the benefits received by owner-occupiers, abed + bfe.

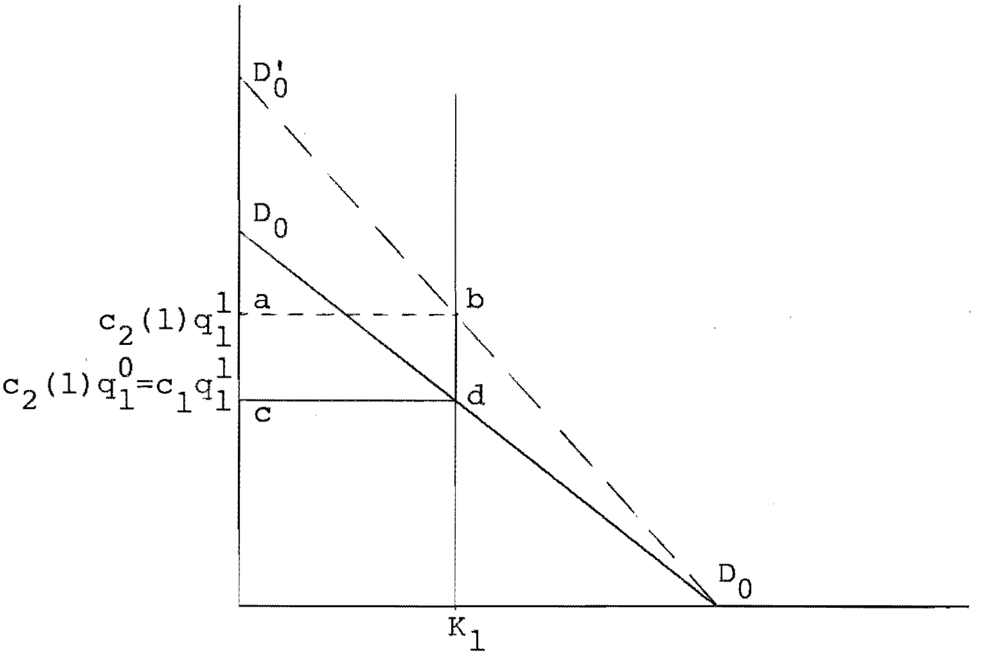
An alternative supply assumption is that the stock of owner-occupied housing is in fixed total supply. This case is illustrated in Figure 2-3-1(b). The effect of the subsidy is to cause house prices to rise from q_1^0 to q_2^1, with no change in annual user costs. i.e., the whole of the subsidy is capitalised in housing stock values. There is no deadweight efficiency loss.

FIGURE 2-3-1:

(a) Perfectly Elastic Supply:



(b) Perfectly Inelastic Supply:

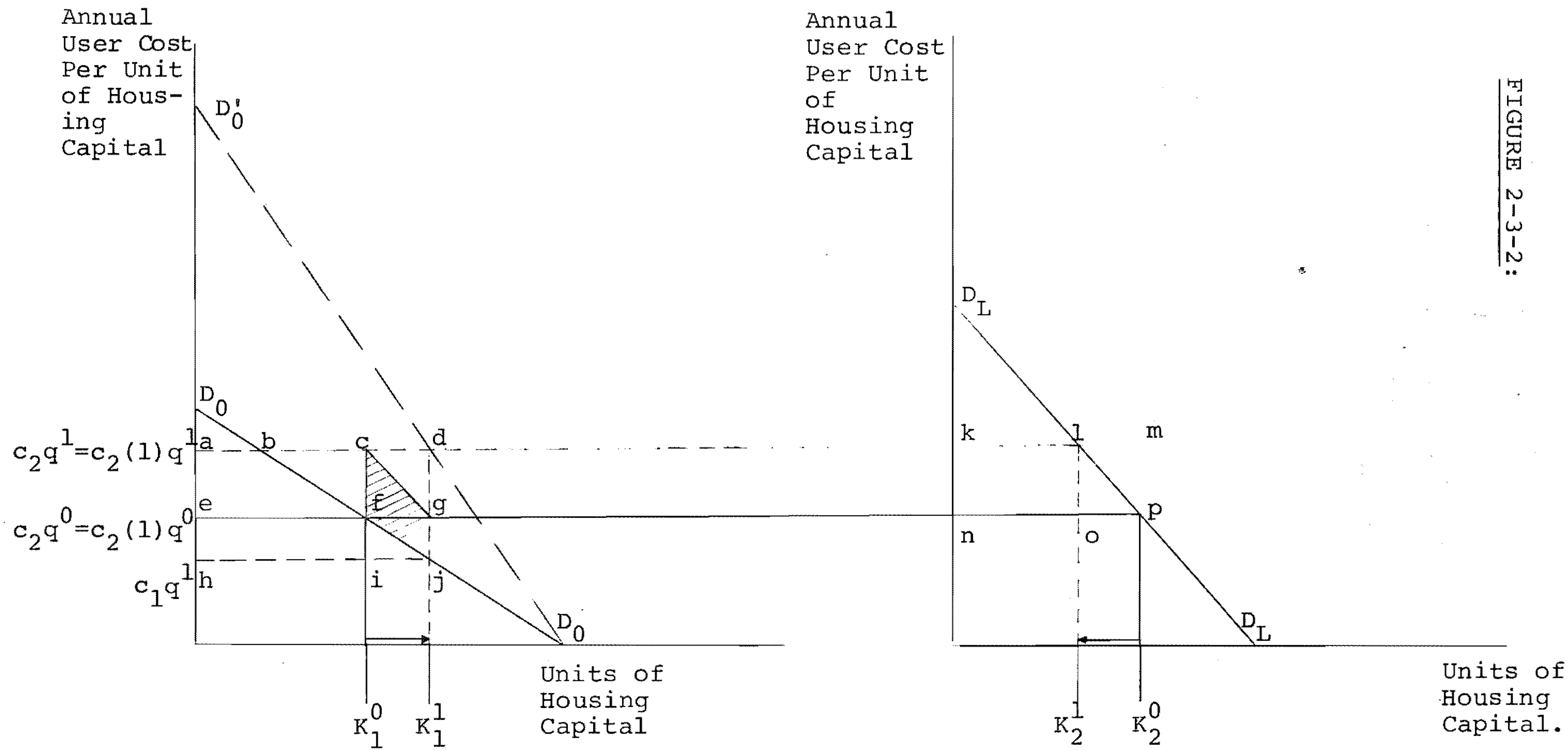


Each of the extreme cases illustrated in Figure 2-3-1 is an unrealistic description of actual adjustments. They can be interpreted as showing the beginning and end points of a more complex adjustment process. White and White (1977) suppose that housing is perfectly substitutable between uses, and they allow the supply schedule for housing to have any positive elasticity. Their analysis views housing demand as a consumption decision. The investment motive is preferred here. The comparative static results are the same, but the investment analysis, because of the key role played by the user cost of capital, indicates which of the components of the "price of owner-occupied housing"[31.] are affected as a "direct" consequence of a change in government policy, and which change subsequently as market forces respond to those direct impacts. The present analysis, illustrated in Figure 2-3-2, examines the simplest case of a perfectly inelastic total supply of housing.[32.]

In Figure 2-3-2, D_2D_2 is the landlord's demand curve. Before the subsidy, the annual unit user costs of housing are $c_2q^0=c_2(1)q^0$ for both landlords and owner-occupiers (if $r_c=r_m$, a set of sufficient conditions for this is $m_1=m_2$, $t_1=t_2$, $\delta_1=\delta_2$, $\hat{\theta}_1=\hat{\theta}_2$, and $u_1=u_2$. Since housing is perfectly substitutable between uses $q_1=q_2(=q)$.) When the subsidy is introduced, the stock of owner-occupied housing increases by $(K_0^1-K_1^0)$, and the stock of rented housing falls by $(K_2^0-K_2^1)=-(K_1^1-K_1^0)$. The annual user costs facing owner-occupiers are c_2q^1. Hence, owner-occupiers pay smaller user costs for more housing, and landlords (and, hence, renters) pay larger "user costs" for less housing. The cost of the subsidy program to the government is $(c_2(1)q^1-c_1q^1)K_1^1$. This is the area of the rectangle adjh. Following White and White (1977) it is possible to identify areas of gain and loss for each of the agents in the market, and so to compute the deadweight efficiency loss associated with the subsidy.

The whole of the area klon represents the addition to landlords' user costs on the units of housing K_2^1. Under present assumptions this is all passed on to renters, with no overall loss in welfare. Owner-occupiers gain acih on units occupied before the subsidy (i.e., K_1^0); acfe is the increase in the annual implicit rental value of the housing occupied, and efih is the reduction in its annual cost. This gain to owner-occupiers sets off against an equal amount of subsidy. The remaining amount of the subsidy is the area cdji paid out on the $(K_1^1-K_1^0)=-(K_2^1-K_2^0)$ units of housing transferred from rental use to owner occupancy. Landlords sell this amount of housing to owner-occupiers for an annualised price of $lmK_2^0K_2^1 = cdK_1^1K_1^0$. But the value of output produced by owner-occupied housing increases by only $fjK_1^1K_1^0$, and the value of output produced by rented housing falls by $lpK_2^0K_2^1$. Hence, the deadweight loss associated with the transfer of housing between uses is

FIGURE 2-3-2:


Annual User Cost Per Unit of Housing Capital
D'0
D0
c2q1=c2(1)q1
a
b
c
d
e
f
g
c2q0=c2(1)q0
c1q1
h
i
j
D0
K01
K11
Units of Housing Capital
Annual User Cost Per Unit of Housing Capital
DL
k
l
m
p
n
o
DL
K12
K02
Units of Housing Capital.

$$D.W.L. = lpK_2^0K_2^1 - fgK_1^1K_1^0$$

$$= lpo+fgj=cgf+fgj$$

This area has been shaded in Figure 2-3-2.

The partial equilibrium analysis illustrated in Figure 2-3-2 indicates the qualitative impact of the owner-occupier subsidy, in terms of its implications for horizontal equity (the difference between housing costs of owner-occupiers and landlords), for house prices (this is the issue of incidence), and economic efficiency. A similar analysis could be performed for any of the tax policy disturbances considered earlier in this Section. White and White (1977) employ an analysis similar to that described here to try to quantify the efficiency cost of the owner-occupier subsidy in the United States of America.

The White and White (1977) analysis is superior to the Laidler (1969) analysis in many respects. It might be noted, however, that the White and White paper does not present as important a contribution to public finance as the authors claim. White and White devote a significant portion of their paper to a statement that when government taxation policies have differential impacts on different agents in the same market, use of the market demand curve to calculate deadweight efficiency losses biases measures of those losses downwards. The reason is that use of the market demand curve ignores the losses associated with transfers among different classes of agents operating in the same market. To emphasise this point, White and White consider the efficiency losses due to the owner-occupier subsidy when the supply curve for housing is perfectly inelastic (this is the case considered above, in Figure 2-3-2). As is well-known, in this case, use of the market demand curve to estimate the deadweight loss associated with the subsidy would produce an estimate of zero. In fact, White and White demonstrate (as was demonstrated in Figure 2-3-2) that the deadweight loss exceeds zero. There are at least two important points that should be made about this aspect of the White and White (1977) paper. The first is that it is not clear to what extent applied welfare economists have made use of market demand curves to estimate welfare losses associated with tax policies aimed at a particular class (only) of agents in the market. The second, and more important, point is that there is nothing new in what White and White have said; it has all been said before. In fact, the White and White analysis of the owner-occupier subsidy when supply is perfectly inelastic describes a tax incidence problem which is formally identical to the problems of the incidence and efficiency aspects of the taxation of income from capital, considered by Harberger (1962), (1966). White and White make no mention of the Harberger tax incidence analysis. Their diagrammatic analysis is essentially equivalent to the diagrammatic analysis presented in Harberger (1966), however.

The next Chapter presents a three-sector general equilibrium model of tax incidence to analyse the owner-occupier subsidy. The model presented there generalizes each of the partial equilibrium cases considered in this Section; it also generalizes the two-sector general equilibrium model of Harberger (1962), (1966). Chapter 4 applies the general equilibrium model to obtain some numerical results for Australia, Canada, New Zealand, the United Kingdom, and the United States. That Chapter also explicitly relates the three-sector general equilibrium model to the Laidler (1969) model referred to above. The case for developing a three-sector general equilibrium model to explore the implications of the owner-occupier subsidy was argued in some detail in Chapter 1.

Footnotes to Chapter 2:

1. See Aaron (1970), (1972), Laidler (1969), White and White (1977), Reece (1975), Kiefer (1978), for instance. Kiefer (1978) develops a "user cost" of capital approach as well, although his approach is significantly different from that pursued here. Kiefer recognises that the production of housing services uses land and labour, together with housing capital. However, Kiefer discovers that the implications of housing policy are adequately analysed if only housing capital is used. The most significant difference between the Kiefer analysis and that developed here is related to the treatment of capital gains. This source of difference is examined in some detail in Section 2.2.

2. This is analogous to the environment of the corporate investor in the Jorgenson neoclassical investment literature: Jorgenson (1967), for instance.

3. Defined below.

4. A unit of housing might be thought of as a dwelling unit, or as one square foot of dwelling-space, or as one of an infinite variety of quantitative measures.

5. There are no liquidity constraints.

6. There are no transactions costs associated with the acquisition of debt.

7. A tax "rebate" differs from a tax "deduction" in that a "rebate" is a reduction in tax liability of the amount of the "rebate", whereas a "deduction" is a reduction in taxable income of the amount of the "deduction".

8. This is the notation employed by Dorfman (1969).

9. Pontryagin et. al. (1962).

10. The Modigliani-Miller conclusion is examined again, below.

11. Of course, there is no need to restrict this expression to housing capital. Interpreted more broadly, this measure of user cost is, in fact, a generalisation (to include debt, among other things) of the user cost of capital employed in the (Jorgenson) neoclassical theory of investment.

12. This might be illusory, of course: The landlord may actually have some market power. The essence of perfect competition is that the agent acts "as if" he has not market power.

13. Time arguments are suppressed here and in what follows. The subscript "2" is introduced to distinguish rented housing from owner-occupied housing. Owner-occupied housing will be denoted by a subscript "1". These subscripts are employed throughout this thesis.

14. Hence, $\hat{\theta}_2=\theta_2$. The same is assumed for owner-occupied housing: $\hat{\theta}_1=\theta_1$.

15. This is not how Laidler (1969) defines the subsidy, and the computation of the subsidy here follows quite a different procedure from that followed by Laidler. Nevertheless, the unit subsidy actually derived here is identical to that which Laidler would compute, following his methodology. The Laidler (1969) procedure is examined in greater detail in Chapter 4.

16. These relations are defined only for $\bar{u}_1>0$.

17. Owner-occupiers will benefit from such a move, however, if housing stock prices (q_1) fall as a result of the move.

18. This is the subject of King and Atkinson's (1980) study.

19. King and Atkinson (1980, p.10) obtain a similar condition, but ignore the differential incidence of rates and property taxes on owner-occupiers and local authority tenants.

20. In the United States case, these "roll-over" provisions apply to all assets, not just producer durables.

21. It is also assumed that depreciation allowances on rented housing reflect true economic depreciation. This might not be realistic, however. Under United States tax legislation, there are accelerated depreciation (in excess of straight-line) for rented housing. Since the present formulation assumes that true economic depreciation is exponential, it might be that $\zeta_2=1$, but there is no way of being sure of this.

22. This subsidy is examined in Chapter 4.

23. This value is employed by Laidler (1969).

24. Strictly, this analysis refers to the "representative" owner-occupier, and the "representative" landlord.

25. Each of the partial derivatives specialises for owner-occupied and rented housing, in each of the countries considered in Section 2.3.

26. This condition is the same, whether before the provision of the tax rebate on mortgage interest, or after.

27. dq_1 is the value of capital gains accruing on one unit of housing. Mortgage interest payments are tax deductible, so that $\bar{u}_1 r_m dq_1$ of interest payments are effectively paid by the government, leaving the individual $r_m dq_1 - \bar{u}_1 r_m dq_1 = (1-\bar{u}_1) r_m dq_1$ to pay.

28. King and Atkinson (1980) examine the implications of this aspect of United Kingdom tax legislation.

29. Section 2.2

30. This is before the new equilibrium is established.

31. This is the term employed by White and White (1977). They avoid a precise definition of this term.

32. This makes it easier to relate this analysis to the general equilibrium analysis of Chapters 3 and 4, which contemplate a three-sector model with a fixed total supply of capital. In each case, the efficiency losses due to the favourable tax treatment of owner-occupied housing are caused by distortions in the allocation of capital among uses.

CHAPTER THREE

STATIC THREE-SECTOR MODEL OF GENERAL EQUILIBRIUM

In this chapter, a static three-sector, two factor general equilibrium model of tax incidence is developed. It is shown how this model might be applied to an examination of the incidence and efficiency aspects of the favourable tax treatment of owner-occupied housing. Three sectors are identified: owner-occupied housing, rented housing, and "other industry".

While the three-sector model developed here has its origins in the simpler two-sector model of Harberger (1962), it embodies some important departures from that model. In particular, following the argument of Ballentine and Eris (1975), the model developed here explicitly introduces income effects into demand equations. Further, unlike the Harberger model, the present model is formulated in a manner which does not require that all initial (i.e., pre-disturbance) taxes are zero; it is not even necessary that the pre-disturbance economy is characterised by neutral tax policies.[1.]

The Harberger (1962) model has been reviewed extensively in Shoven and Whalley (1972), Shoven (1976), McLure (1974), (1975), Ballentine and Eris (1975), and Mieszkowski (1967). McLure (1975) also appraises the various extensions to, modifications and applications of, the Harberger model since 1962. Shoven and Whalley (1972,

Appendix B) explicitly derive the equations which describe the Harberger model. These same equations have been presented in McLure (1975) and Boskin (1975), and have been discussed in some detail in Mieszkowski (1976). There is, in consequence, no need to present the Harberger two-sector model here. In any case, the Harberger model is a special case of the more general three-sector model developed in Section 3.3, below.

The Harberger model of tax incidence is a particular characterization of the standard static two-sector, two factor general equilibrium model developed originally by Meade (1955) and Johnson (1956) for the study of international trade. The Harberger analysis is not the only characterization of this model to be employed in the examination of tax incidence questions, however. Other, related, analyses appear in Johnson (1966), Johnson and Mieszkowski (1970), Herberg, Kemp, and Magee (1971), Magee (1971), Jones (1971), among others.

While the Harberger model is developed from the neoclassical two-sector, two factor model of general equilibrium, the model of tax incidence derived in Section 3.3 is a characterization of the three-sector, two factor general eqilibrium model implicit in parts of the analyses of Samuelson (1953, esp. p.7), Meade (1950), Travis (1964, pp.140-43)[1], and exploited in Melvin (1968). Traditionally, interest in the three-sector, two factor model of general equilibrium has been confined to the analysis of international trade. In this context, it has been shown (by

Melvin, in particular) that there is an indeterminacy in production when countries are permitted to trade. The reason for this result is that when the number of products exceeds the number of factors, the production possibility frontier, while convex, will necessarily contain flat planes and straight lines. Melvin (1968) has shown that in the particular case of three products and two factors, the production possibility frontier is a ruled surface, in the sense that it can be completely described by straight lines; Kemp, Manning, Tawada, and Nishimura (1980) have generalised this result. There is no reason, however, why there should be any indeterminacy in production when the economy is closed to international trade: In general, we should still expect a unique equilibrium pattern of production in the closed economy case.

The Harberger-type class of tax incidence models (to which the model developed in Section 3.3 belongs) is not the only class of such models. Shoven and Whalley (1972), (1973) present an algorithmic solution procedure for a general equilibrium model (due to Scarf (1973)), and use this procedure to explore the same questions addressed by Harberger (1962), (1966).[2.]

Shoven and Whalley claim that the algorithmic approach is superior to the Harberger approach for four main reasons:

(1) The algorithmic formulation requires none of the linearity assumptions employed by Harberger, and is therefore better suited to an analysis of taxes of finite size;

(2) the algorithmic formulation is not restrictive in the number of sectors or factors embodied in the model;

(3) the algorithmic formulation permits the analysis of several distortions simultaneously; and

(4) the algorithmic formulation lends itself to dynamic extensions.

Balanced against these advantages is the fact that the algorithmic approach permits estimates of welfare loss to be identified within upper and lower bounds, only. The differences between the upper and lower bounds can be quite large.[3.] In defence of the Harberger approach, it should be noted that although the particular model presented in Harberger (1962) is restrictive in both the number of sectors and the number of simultaneous distortions considered, it has not been demonstrated that the general Harberger methodology is necessarily restrictive in either sense. Indeed, the analysis presented in Section 3.3 demonstrates that the Harberger methodology permits some generalization.

It seems unlikely that the algorithmic approach offered by Shoven and Whalley will ever completely replace the Harberger-type models of tax incidence. This, in itself, constitutes a good reason for economists to continue to modify and to extend the Harberger (1962) model, endeavouring (as much as is possible) to overcome whatever limitations that model might suffer from. The three-sector, two factor model developed in this chapter is such an attempt.

This chapter is divided into six sections. Sections 3.1 and 3.2 are concerned with the elaboration of certain concepts which arise in the development of the general equilibrium model. Section 3.3 develops the model algebraically. Section 3.4 analyses the distribution of the burden of non-neutral taxation among capital and labour.[4.] Section 3.5 relates the measurement of the welfare costs of non-neutral taxation to the model developed in Section 3.3. And Section 3.6 is concerned with second-best optimal tax policy. The issue analysed there is, given that governments are committed to a policy of taxing owner-occupied housing favourably relative to rented housing, what are the second-best rates of tax which might be levied on capital in each sector? The second-best tax rates are those which minimize the welfare cost of the owner-occupier subsidy.

3.1 INCOME AND EXPENDITURE TERMS IN THE "USER COST" OF CAPITAL

Chapter 2 developed an expression for the user cost of housing capital, and exploited that expression in a partial equilibrium analysis of housing policy. This Section divides the user cost expression into its income and expenditure components, so that it might be employed in the development of a general equilibrium model, in Section 3.3. In addition, this Section examines the extent to which the user cost expression derived in Chapter 2 is applicable to assets employed in non-residential uses; in particular, in corporate activity.

For capital employed by unincorporated enterprises the user cost expression of Chapter 2 is equally useful whether the capital is employed in residential or non-residential uses. For present purposes, the important difference between corporate and unincorporated enterprise is the separation of ownership and control of capital in the former. Hence, in corporate activity, capital is employed in production, by producers who need not have any equity in the capital they employ: The asset-user is not the asset-owner. For the corporate production manager, the return on equity is part of the (user) cost of employing capital in production. If the producer wants to acquire more capital, for instance, he might borrow money to obtain the necessary finance (this is debt-financing), or he might issue shares (this is equity-financing), in which (latter) case the capital is effectively owned by the shareholder. In the first case, the producer (asset-user) pays interest charges on debt. In the second case, the producer pays a "required" rate of return on equity. Accordingly, there is no obvious reason why the asset-user (the corporate production manager) might seek to maximize the present net worth of (asset-)owners' equity, as was assumed in Chapter 2. (Of course, competition for equity funds will maximize asset-owners' net worth, anyway.)

It turns out that the user cost expression of Chapter 2 does not need much amendment to make it suitable for use in the case of corporate activity. What is needed is an appropriate interpretation of the opportunity cost component of user cost. The value of capital employed in corporate activity is either debt or equity capital: Using the superscript "c" to denote corporate activity, the value of debt capital is $\phi_i^c q_i K_i^c$, and the value of equity capital is $(1-\phi_i^c)q_i K_i^c$. The opportunity cost of equity is a cost facing the owner of equity (shareholder), not (directly, anyway) the corporate user of equity. If the owner of equity is willing to invest his equity in corporate activity, it must be because the net rate of return on corporate Sector equity is at least as high as the rate of opportunity cost on equity. In an equilibrium, there must be equality. But this means that the cost of equity to the corporation is

$$r_c(1-\phi_i^c)q_i K_i^c.$$

Of this, the government takes

$$u_i r_c(1-\phi_i^c)q_i K_i$$

by way of individual income taxes, leaving the owners of equity with

$$(1-u_i)r_c(1-\phi_i)^c q_i K_i^c,$$

which is the opportunity cost of equity. Of course, the cost of debt to the corporation is

$$r_m \phi_i^c q_i K_i^c$$

On using (2-2-1), the user cost of corporate capital is

$$(3\text{-}1\text{-}1) \quad C_i^c = \frac{q_i\{r_c(1-\phi_i^c)+(1-\beta_i^c u_c)r_m\phi_i^c+(1-\gamma_i^c u_c)m_i + (1-\varepsilon_i^c u_c)t_i+(1-\zeta_i^c u_c)\delta_i-(1-\Delta_i^c\lambda_i^c u_c)\hat{\theta}_i\} - R_i^c}{(1-\alpha_i^c u_c)}$$

<u>where</u>: 1. u_c is the corporation income tax rate.

2. q_i, m_i, t_i, δ_i, $\hat{\theta}_i$ are sector-specific, but are the same in both corporate and unincorporated activity.

3. All variables have been defined in Chapter 2.

(3-1-1) differs from (2-2-1) by including a term

$$\frac{u_i r_c(1-\phi_i^c)q_i}{(1-\alpha_i^c u_c)}$$

which is excluded in (2-2-1). $u_i r_c(1-\phi_i^c)q_i$ is simply individual tax liability on one unit of equity capital employed in corporate activity.

The equilibrium condition from the equity-owner's point of view has already been stated. Where the equity-owner and equity-user are the same entity, this equilibrium condition is equivalent to the condition that might also be derived from the equity-user's point of view. But where the equity-owner and equity-user are different entities, the equilibrium conditions are not equivalent. In this case it is appropriate to treat the equilibrium conditions sequentially: The first condition (that for the equity-owner) ensures that the net rate of return on equity equals the net rate of opportunity cost; the second condition (that of the equity-user) is that, as the result of profit maximization on the part of competitive users of capital, the user cost per unit of capital (including, where appropriate, the payments made as a return to equity) is driven to equality with the value marginal product of capital. In competition, the value marginal product of capital employed in Sector i is its gross rental value there (denoted $P^*_{K_i} \equiv MP_{K_i} . P_i$, where MP_{K_i} is the marginal physical product of capital employed in Sector i, and P_i is the price of Sector i output). i.e., equilibrium requires:

$$P^*_{K_i} = C_i, \tag{3-1-2}$$

and this is true for capital employed in both corporate and unincorporated activity.

(3-1-2) in (3-1-1) reveals, on using (2-1-9), that the rate of corporate income tax, per unit of corporate capital, is

$$\frac{\begin{aligned} q_i\{\alpha^c_i u_c r_c(1-\phi^c_i) &+ u_c(\alpha^c_i-\beta^c_i) r_m \phi^c_i + u_c(\alpha^c_i-\gamma^c_i) m_i \\ &+ u_c(\alpha^c_i-\varepsilon^c_i) t_i + u_c(\alpha^c_i-\zeta^c_i)\delta_i \\ &- u_c(\alpha^c_i-\Delta^c_i\lambda^c_i)\acute{\theta}_i\} - R^c_i \end{aligned}}{(1-\alpha^c_i u_c)}$$

Total income taxes (corporate plus individual) levied on corporate capital are, per unit of corporate capital:

$$(3\text{-}1\text{-}3) \quad \Pi_i^c = \frac{q_i\{\alpha_i^c u_c(1-u_i)r_c(1-\phi_i^c)+u_i r_c(1-\phi_i)+u_c(\alpha_i^c-\beta_i^c)r_m\phi_i^c +u_c(\alpha_i^c-\gamma_i^c)m_i+u_c(\alpha_i^c-\varepsilon_i^c)t_i+u_c(\alpha_i^c-\zeta_i^c)\delta_i -u_c(\alpha_i^c-\Delta_i^c\lambda_i^c)\hat{\theta}_i\}-R_i^c}{(1-\alpha_i^c u_c)}$$

The unit income tax on unincorporated capital in Sector i is, on using (2-1-9) in (3-1-2), (3-1-1):

$$(3\text{-}1\text{-}4) \quad \Pi_i^u = \frac{q_i\{\alpha_i^u u_i(1-u_i)r_c(1-\phi_i^u)+u_i(\alpha_i^u-\beta_i^u)r_m\phi_i^u+u_i(\alpha_i^u-\gamma_i^u)m_i +u_i(\alpha_i^u-\varepsilon_i^u)t_i+u_i(\alpha_i^u-\zeta_i^u)\delta_i -u_i(\alpha_i^u-\Delta_i^u\lambda_i^u)\hat{\theta}_i\}-R_i^u}{(1-\alpha_i^u u_i)}$$

where the superscript "u" denotes unincorporated activity. The "double taxation" of corporate capital is reflected in the term

$$\frac{u_i r_c(1-\phi_i)q_i}{1-\alpha_i^c u_c},$$

which appears in (3-1-3), but not in (3-1-4).

(3-1-4) in (2-2-1) reveals that in the case of unincorporated activity, the user cost of capital can be written:

$$(3\text{-}1\text{-}5) \quad c_i^u = (1-u_i)r_c(1-\phi_i^u)q_i+r_m\phi_i^u q_i+t_i q_i+(m_i+\delta_i)q_i -\hat{\theta}_i q_i+\Pi_i^u ,$$

while (3-1-3) in (3-1-1) reveals that in the case of corporate activity, the user cost of capital can be written:

$$(3\text{-}1\text{-}6)\quad C_i^c=(1-u_i)r_c(1-\phi_i^c)q_i+r_m\phi_i^c q_i+t_i q_i+(m_i+\delta_i)q_i -\hat{\Theta}_i q_i+\Pi_i^c.$$

Hence, in general:

$$(3\text{-}1\text{-}7)\quad C_i=(1-u_i)r_c(1-\phi_i)q_i+r_m\phi_i q_i+t_i q_i+(m_i+\delta_i)q_i -\hat{\Theta}_i q_i+\Pi_i.$$

Denote user costs net of depreciation, repairs, maintenance, casualty insurance premiums, and indirect taxes, by C_i'. In equilibrium, this is equal to the net-value-added, or net-product at factor cost, derived from one unit of capital employed in Sector i. Denoting this net-value-added by NVA_i, equilibrium is characterized by:

$$(3\text{-}1\text{-}8)\quad NVA_i=C_i'=(1-u_i)r_c(1-\phi_i)q_i+r_m\phi_i q_i-\hat{\Theta}_i q_i+\Pi_i.$$

Total income derived from capital employed in Sector i (denoted Y_{K_i}) is defined as the sum of net-value-added and capital gains. i.e.,

$$(3\text{-}1\text{-}9)\quad Y_{K_i}\equiv\{NVA_i+\hat{\Theta}_i q_i\}K_i$$

$$=\{(1-u_i)r_c(1-\phi_i)q_i+r_m\phi_i q_i+\Pi_i\}K_i,$$

where it has been assumed that expected capital gains $\hat{\Theta}_i q_i K_i$ actually accrue.

It has been demonstrated that $(1-u_i)r_c(1-\phi_i)q_iK_i$ is the net income due to owners' equity. The net income due to the mortgagee is $(1-u_m)r_m\phi_i$,[5.] where u_m is the mortgagee's individual tax rate. The rest of the income in (3-1-9) goes to the government by way of income taxes. The government collects $\Pi_iK_i+u_mr_m\phi_iq_iK_i$ in income tax revenue.

It is convenient to separate private and government income components in (3-1-8) and (3-1-9). To this end, denote the after-tax net-value-added of one unit of capital in Sector i by P_{K_i}, so that in equilibrium,

$$(3\text{-}1\text{-}10) \quad P_{K_i} = C_i'-\Pi_i-u_mr_m\phi_iq_i$$
$$= (1-u_i)r_c(1-\phi_i)q_i+(1-u_m)r_m\phi_iq_i-\hat{\Theta}_iq_i.$$

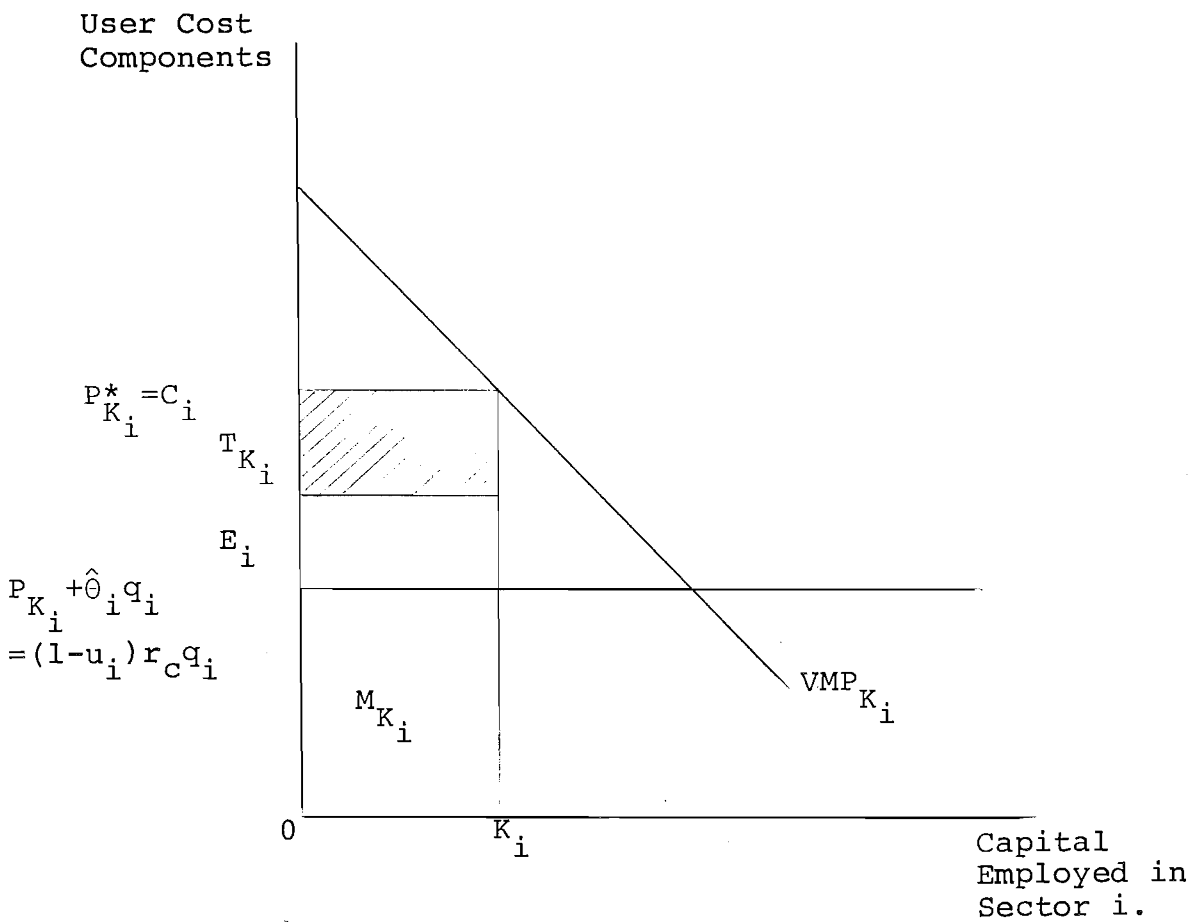
P_{K_i} is sometimes referred to as the net-rental price of capital in Sector i. Further, denote total private income derived from capital employed in Sector i by M_{K_i}. Then, in equilibrium,

$$(3\text{-}1\text{-}11) \quad M_{K_i} \equiv \{NVA_i+\hat{\Theta}_iq_i-\Pi_i-u_mr_m\phi_iq_i\}K_i$$
$$\equiv \{P_{K_i}+\hat{\Theta}_iq_i\}K_i$$
$$= \{(1-u_i)r_c(1-\phi_i)q_i+(1-u_m)r_m\phi_iq_i\}K_i.$$

Arbitrage on the part of owners of capital ensures that the after-tax rate of return on debt equals the after-tax rate of return on equity.[6.] Then, (3-1-11) simplifies to:

$$(3\text{-}1\text{-}12) \quad M_{k_i} = (1-u_i)r_cq_iK_i = (1-u_m)r_mq_iK_i$$

FIGURE 3-1-1:



$E_i \equiv (m_i+\delta_i-\hat{\Theta}_i)q_i$

$T_{K_i} \equiv \Pi_i+t_iq_i+u_mr_m\phi_iq_i$

Figure 3-3-1 illustrates the various components of the user cost of capital employed in Sector i. The schedule VMP_{K_i} is the value marginal product schedule for capital in Sector i. The schedule is downward sloping, reflecting a diminishing marginal physical product. Capital is employed to the point where its value marginal product is equal to its user cost. It is assumed that capital has the same capital value in each sector. i.e., $q_i=q_j(\forall i,j)$. Then, $(1-u_i)r_c q_i$ is also the same for capital employed in each sector. The gross rental price $P^*_{K_i}$ will normally be different among sectors because of differences in unit tax rates, $T_{K_i} \equiv \Pi_i+t_i q_i+u_m r_m \phi_i q_i$, and because of differences in m_i, and δ_i. The shaded rectangle represents total <u>taxes,</u> $T_{K_i}K_i$, levied on capital employed in Sector i. The rectangle labelled M_{K_i} is the area of <u>net income</u> derived from capital employed in Sector i, excluding government income, $T_{K_i}K_i$. The rectangle E_iK_i represents <u>expenses</u> incurred inproviding K_i units of capital for one period (these might be thought of as intermediate costs).

3.2 TAX INCIDENCE, TAX SHIFTING, AND TAX NEUTRALITY

The imposition of a tax on the income of capital employed in any sector of the economy will usually alter both the gross and net rental prices of capital employed in that and other sectors. It is useful to refer to the effect of the imposition of the tax on the net rental price of capital as the incidence of the tax on the "sources" side of the budget. In addition, the imposition of the tax usually affects commodity prices, and it is useful to refer to this effect as the incidence of the tax on the "uses" side of the budget.

The incidence of a tax on capital income is related to the extent to which the tax burden is "shifted". In the case of excise taxes on consumer goods, the question of tax shifting concerns the ability of sellers (who bear the "impact" of the tax[7].) to pass the tax onto buyers (This is forward-shifting.); the extent to which the tax may be shifted depends upon the shapes of the relevant demand and supply curves. In the case of a tax on capital income (such as the corporation income tax), tax shifting relates to the ability of asset-users (who bear the "impact" of the tax in this case) to pass the tax onto asset-owners through lower net rental prices (net rates of return) on capital (This is backward-shifting.), or onto other factors employed with capital in the production process. If, for instance, it is found that the imposition of a tax on capital in one sector causes the net rental price on capital (P_{K_i}) to fall by the full amount of the tax there is full tax shifting, and capital is said to bear the full burden of the tax.

The question of tax shifting has become the subject of some controversy, particularly in the context of corporate taxation.[8.] Hall and Jorgenson (1967), (1969) assume that the "required rate of return" on corporate equity is constant in <u>pretax</u> terms (i.e., $\partial r_c/\partial u_c=0$). At the other extreme, Coen (1968) assumes that the "<u>net</u> discount rate" is independent of the tax rate. As was noted in Chapter 1, Ott and Ott (1973) avoid the question, but their analysis reveals an implicit assumption that the imposition of a tax on capital in Sector i does not affect the net rental price of capital in that Sector. This is equivalent to the assumption made by Coen (1968).

Sumner (1973) argues that neither of the Hall and Jorgenson, nor Coen, assumptions is acceptable. He suggests that: "Hall and Jorgenson, like tax legislation, ignore the opportunity-cost element in the return to shareholders. Coen's version is valid only for a partial equilibrium model of a world in which equity funds are the sole source of finance."[9.]

The "impact" of the corporation income tax falls on the asset-user. The Hall and Jorgenson assumption implies that there is full shifting of the tax. i.e., that the net rental price of capital employed in the corporate sector falls by the full amount of the corporation tax. But, as Sumner seems to have in mind,[10.] if the corporation tax is fully shifted, the after-tax rate of return on equity invested in the corporate Sector falls relative to investments in unincorporated enterprises, causing equity funds to move out of the corporate Sector, and so raising rates of return there.

As to Coen's assumption, if there is no shifting of the corporation tax, then, since debt interest escapes the tax while equity interest does not, the existence of the tax separates the costs of debt and equity to the corporation (the asset-user). Hence, it would be natural to expect the corporation income tax to induce corporate enterprises to subsitute from equity- to debt-finance. Tambini (1969) is concerned with precisely this problem: "Why corporations do not try to avoid the tax entirely, or at least to avoid more of it, by shifting more to debt financing becomes quite a puzzle if we consider that debt and equity are perfect substitutes in production; corporate income is produced by corporate assets, and the value of the marginal physical product of one dollar's worth of assets is the same, no matter how it is financed. We would accordingly expect large shifts from equity to debt capital and vice versa for small divergences in their respective costs."[11.] But Tambini notes that such shifts do not seem to have occurred: "Over the entire period 1927-60, the cost of equity capital has exceeded the cost of debt capital, generally by a non-trivial amount; the difference has tended to increase over time, becoming quite substantial in the last two decades. However, corporations over the same period continued to finance the larger part of their assets through equity."[12.] Sumner would apparently regard this as evidence that there has been some shifting of the corporation income tax. Tambini calculates, however, that when differential risk arguments are considered, the marginal costs to corporate enterprises of debt and equity were equal in 1965, even under the assumption of approximately no shifting of the corporation income tax. Accordingly, it is not clear that Coen's assumption is unrealistic.

Section 3.1 noted that arbitrage by owners of capital ensures that the net-of-tax rate of return on debt equals the net-of-tax rate of return on equity. This result does not imply that there has been no shifting of the corporation income tax, although it does imply that the average cost of debt exceeds the average cost of equity in corporate activities (if u_i is approximately equal to u_m). Implicit in the present analysis is the idea that the supplies of debt and equity are perfectly substitutable. Then, an increase in the tax rate on equity will normally reduce both the net rate of return on equity, and the net rate of interest on debt; it is not necessary that there be no shifting of taxes on equity. This attitude permits both the gross- and net-of-tax rates of return on capital to be affected by government tax policies. In particular, each of these rates of return is determined endogenously, which is a significant departure from the partial equilibrium models referred to in Chapter 2.

In the three-sector general equilibrium model developed in this Chapter, the questions of tax incidence and tax shifting are of fundamental importance. In general, taxes on capital in one sector are shifted to some extent, but not fully. The extent of the shifting depends upon factor shares in that and other sectors, factor intensities and absolute factor employments, the elasticities of factor substitution in each sector, the own-price and cross-price elasticities of demand for sectoral outputs, and the income elasticities of demand for sectoral outputs.

Much of the analysis of this Chapter is concerned with distortions due to the non-neutral taxation of income from capital. In this context, the pre-disturbance economy is characterised by a system of neutral taxation of factor incomes (commodity excise taxes are ignored.). The public finance literature indicates a consensus of opinion on the implications of neutral taxation, but there seems to be some confusion over precisely what sorts of income taxes are sufficient to yield those implications. Because this issue is critically important in the present analysis, the concept of tax neutrality in general equilibrium models is explored in the remainder of this Section.

In general, taxation is said to be neutral if it does not alter the pattern of equilibrium that would pertain without taxes.[13.] In a general equilibrium context, such taxes might be interpreted as those which do not alter the ratios of gross-of-tax factor prices, and gross-of-tax commodity prices.

Cost-minimization in production implies that

$$\frac{P^*_{K_i}}{P_{L_i}} = \frac{MP_{K_i}}{MP_{L_i}} \qquad \forall i.$$

<u>where:</u> P_{L_i} is the gross-of-tax wage rate paid labour in sector i.

MP_{L_i} is the marginal physical product of labour in sector i.

The marginal cost of sector i output (denoted MC_i) is

$$MC_i = P^*_{K_i}/MP_{K_i} = P_{L_i}/MP_{L_i}, \qquad i=1,2,3$$

In the absence of externalities, monopoly elements, and commodity excise taxes, output prices reflect marginal costs. The ratio of marginal costs between Sectors i and j is

$$\frac{MC_i}{MC_j} = \frac{P^*_{K_i}/MP_{K_i}}{P^*_{K_j}/MP_{K_j}} = \frac{P^*_{K_i}}{P^*_{K_j}} \cdot \frac{MP_{K_j}}{MP_{K_i}}$$

$$= \frac{P_{L_i}/MP_{L_i}}{P_{L_j}/MP_{L_j}} = \frac{P_{L_i}}{P_{L_j}} \cdot \frac{MP_{L_j}}{MP_{L_i}} \qquad i,j=1,2,3$$

The terms MP_{K_j}/MP_{K_i}, and MP_{L_j}/MP_{L_i}, represent the marginal rates of transformation of Sector i output into Sector j output, using compensating increments of capital and labour, respectively. If gross (of tax) factor prices for capital and labour do not differ between sectors, the ratio of marginal costs equals the rate of product transformation. In the present analysis, assume that $P_{L_i} = P_{L_j}$ (i,j=1,2,3). On the other hand, as equations (3-1-1) and (3-1-3) reveal, there may be many reasons why $P^*_{K_i} \neq P^*_{K_j}$ (i,j=1,2,3; i≠j). One reason is that even if there are no taxes on capital, the activity with the higher rate of depreciation on capital will (ceteris paribus) have a larger gross rental price on capital. And, of course, differential tax treatment will generate differentials between $P^*_{K_i}$ and $P^*_{K_j}$ (i≠j).

The effects of differentials $\left|P^*_{K_i} - P^*_{K_j}\right| > 0$, have important objective welfare implications: If $P_{L_i}=P_{L_j}$ and $P_{K_j}=P_{K_i}(1+\partial)$, $(\partial>0)$, for instance, producers in different activities face different relative factor prices. An implication is that, in Sector i production will be more capital intensive, and in Sector j production may[14.] be more labour intensive, than what is Pareto efficient. Accordingly, the economy's production possibility set is contained in the interior of the "first-best" set, except for the extreme points involving complete specialisation. (See Herberg, Kemp, and Magee (1971), for instance.) Taxes which generate this result are clearly not neutral; but, as has been noted, the result does not require the presence of any taxes.

As an alternative, suppose that $P_{L_j} > P_{L_i}$, $P^*_{K_j} > P^*_{K_i}$, $P^*_{K_j}/P_{L_j} = P^*_{K_i}/P_{L_i}$. Then, production will be efficient: The production possibility set is not distorted. However, the solution is not optimal, since the ratio of marginal costs, MC_i/MC_j, will be less than the rate of product transformation. Since consumer prices equal marginal costs underpresent assumptions, the marginal rate of commodity substitution in consumption differs from the marginal rate of commodity transformation in production: A reallocation of factors among industries can make all consumers better off at the prevailing output prices.

If gross wages are the same in all sectors, and if gross rentals on capital are equal among activities, neutral capital taxes are any which alter $P^*_{K_i}$ and $P^*_{K_j}$ in the same proportion. It has already been noted that if the total supply of capital is fixed, capital bears the full burden of a neutral tax, with no effect on gross rental prices. (This is not true of non-neutral taxes, however!) Since gross rental prices are unaffected by the imposition of neutral taxes, so too must the allocation of capital be unaffected.

It can now be shown that with a fixed total capital stock, a neutral tax on capital is one which represents the same proportion of net value-added plus capital gains of capital in each sector. (i.e., $[P_{K_i}+\hat{\theta}_i q_i]K_i$). The reason is that the sum of after-tax net-value added and capital gains is the net income received by the owners of capital. If this net income is the same per unit of capital employed in each sector, then, if a neutral tax is imposed, this net income falls by the full amount of the tax, provided the total stock of capital is fixed. This amounts to an identical unit reduction in net income in each sector. Alternatively, suppose the tax is the same proportion of gross value-added (net value-added plus depreciation), for instance, then the unit reduction in each sector differs according to differential depreciation rates, and this will distort the allocation of capital among sectors. It should be emphasised, however, that an equal percentage tax on net value-added plus capital gains (i.e., net income) in each sector is only neutral if the sum of these two income components is the same per unit of capital in each sector. There are good reasons for expecting this to be true: If a unit of capital yields a higher net income in one sector than another, the present allocation of capital can be expected to change as asset-owners respond to market incentives. It is for this reason that the Simons (1938)-Carter (1966) approach to taxation policy - which emphasises the virtues of an income tax striking all individual income at the same rate - is regarded as approximately neutral.[15].

3.3 DEVELOPMENT OF THE MODEL

The model developed here is designed to permit analysis of the effects of the differential tax treatment of capital. The model supposes that there are three sectors. This amounts to a significant generalization of the Harberger (1962) two-sector general equilibrium model of tax incidence. The three sectors are for rented housing, owner-occupied housing, and "other industry". Combining the rented and owner-occupied housing sectors would permit the use of a simpler two-sector model, but this would prevent analysis of the differential tax treatment of these two groups, one of the most important of all issues in housing policy.

Like the Harberger (1962) model, the present model is formulated to permit comparative static analysis, and is written in the form of total differentials. Apart from this, there are some significant departures from the Harberger methodology. Most importantly, perhaps, the model explicitly introduces income effects into demand equations. Unlike the Harberger model, the model presented here is a valid tool for the analysis of taxes of finite size.

The Harberger model assumes that all individuals and the government have identical consumption patterns. This permits the use of aggregate demand equations (Gorman (1953), Muellbauer (1975)). There is, of course, no loss of generality in this if one assumes that all consumers have the same marginal propensities to consume out of income. As Ballentine and Eris (1975) have indicated, Harberger's discussion (1962, p.224) suggests a belief that the assumption of identical marginal propensities to consume means that all income effects of government and private demand just cancel out. Mieszkowski (1967, p.260, n.10) seems to be of the same opinion. Thus, if one dollar is transferred from individuals to government there is no distortion in the pattern of demand. But this does not mean that the imposition of a tax may be analysed with income-compensated demand equations (as Harberger has done), since it is the absolute level of income, and not merely its distribution as between individuals and government, which changes when a tax is imposed. Thus, if one is to argue that all income effects cancel out one has to assume, in addition, that all taxes are either zero or neutral.

The loss in real income is a frequently used measure of the excess burden of the tax. Harberger (1966) actually uses this measure, along with his model of tax incidence, to estimate the excess burden of the corporation income tax. The aim of his analysis is to measure real income losses while using income-compensated demand curves on the assumption that there are no real income losses.[16] This methodological weakness of the Harberger model does not extend to the model developed here.

The development of comparative static analyses in economics requires the specification of demand and supply equations for at least n-1 of the n non-separable markets[17] which characterise the economy. Walras' Law can be employed to make the last market's equation redundant. The three-sector model developed here specifies demand and supply equations for two of the three product markets, and appeals to Walras' Law to close the third market.

The supply side of the economy is characterized by linear homogeneous production functions, perfect competition, and profit maximization. In addition each industry (i.e., sector) produces only one commodity, and this commodity is unique. Thus

(3-3-1) $$Q_i = f_i(K_i, L_i) \qquad i=1,2,3$$

<u>where</u>: Q_i is physical output of commodity i.

K_i is the quantity of capital services employed in the production of commodity i.

L_i is the quantity of labour services employed in the production of commodity i.

Denote the price of Sector i output by P_i (i=1,2,3). The value of Sector i output which is available for final consumption is P_iQ_i, less the value of the output of that Sector used as intermediate input in the maintenance of capital in all sectors.[18] Hence, denoting the quantity of Sector i output available for final consumption by S_i,

$$(3\text{-}3\text{-}2) \quad P_iS_i = P_iQ_i - \sum_{j=1}^{3} a_{ji}\{q_jK_j(m_j+\delta_j-\hat{\Theta}_j)\}, \qquad i=1,2,3.$$

where: a_{ji} is the percentage of the value of intermediate expenditure on capital in Sector j that absorbs output from Sector i.

By definition,

$$\sum_i a_{ji} = 1, \qquad j=1,2,3.$$

The system of equations (3-3-2) embodies the input-output configuration of this economy: The a_{ji} are the input-output coefficients with respect to intermediate usage. (3-3-2) can be written

$$(3\text{-}3\text{-}3) \quad S_i = f_i(K_i,L_i)\left(1 - \sum_{j=1}^{3} a_{ji}\left\{\frac{q_jK_j(m_j+\delta_j-\hat{\Theta}_j)}{P_iQ_i}\right\}\right), \qquad i=1,2,3.$$

It is convenient to define

$$(3\text{-}3\text{-}4) \quad \Theta^E_{ji} \equiv \frac{a_{ji}q_jK_j(m_j+\delta_j-\hat{\Theta}_j)}{P_iQ_i}, \qquad i,j=1,2,3.$$

Θ^E_{ji} is the share of intermediate expenditure, on capital employed in Sector j, in the output of Sector i.

Labour is taken to be <u>numeraire</u>. This implies that

$$(3\text{-}3\text{-}5) \quad P_{L_i} = 1 \quad , \quad dP_{L_i} = 0 \ , \qquad i=1,2,3.$$

In addition, it is supposed that the expected rate of capital gain $(\hat{\theta}_i q_i)$, the (per unit of capital) costs of repairs, maintenance, and casualty insurance premiums $(m_i q_i)$, and the unit depreciation charges $(\delta_i q_i)$ are invariant with respect to the disturbances analysed here. i.e.,

$$(3\text{-}3\text{-}6) \qquad d\hat{\theta}_i q_i = dm_i q_i = d\delta_i q_i = 0.$$

The model developed here is characterized by fixed factor endowments. Hence:

$$(3\text{-}3\text{-}7)^* \qquad \sum_{i=1}^{3} dK_i = \sum_{i=1}^{3} dL_i = 0.$$

Total differentiation of (3-3-3) reveals, on using (3-3-4) and (3-3-6);

$$(3\text{-}3\text{-}8)^* \quad \frac{dS_i}{S_i} = \left[\frac{1}{1-\sum_{j=1}^{3}\theta^E_{ji}}\right]\left\{\theta_{K_i}\cdot\frac{dK_i}{K_i}+\theta_{L_i}\cdot\frac{dL_i}{L_i}-\sum_{j=1}^{3}\theta^E_{ji}\cdot\frac{dK_j}{K_j}+\frac{dP_i}{P_i}\cdot\sum_{j=1}^{3}\theta^E_{ji}\right\}, \qquad i=1,2,3.$$

<u>where</u>: $\theta_{K_i} \equiv \frac{\partial f_i}{\partial K_i}\cdot\frac{K_i}{Q_i}$ is the elasticity of Sector i output with respect to capital.

$\theta_{L_i} \equiv \frac{\partial f_i}{\partial L_i}\cdot\frac{L_i}{Q_i}$ is the elasticity of Sector i output with respect to labour.

The partial derivatives $\partial f_i/\partial K_i$, $\partial f_i/\partial L_i$, are the marginal physical products of capital and labour, respectively, in Sector i. Under competition, marginal physical products equal real factor prices. i.e.,

$$(3\text{-}3\text{-}9) \qquad \frac{\partial f_i}{\partial L_i} = \frac{P^*_{K_i}}{P_i}, \quad \frac{\partial f_i}{\partial L_i} = \frac{P_{L_i}}{P_i}. \qquad i=1,2,3.$$

Accordingly, under competition, Θ_{K_i} and Θ_{L_i} are the shares of capital and labour, respectively, in the value of Sector i output:

$$(3\text{-}3\text{-}10)\quad \Theta_{K_i} = \frac{P^*_{K_i} K_i}{P_i Q_i} = \frac{[P_{K_i} + T_{K_i} + (m_i+\delta_i) q_i] K_i}{P_i Q_i}, \qquad i=1,2,3.$$

$$(3\text{-}3\text{-}11)\quad \Theta_{L_i} = \frac{P_{L_i} L_i}{P_i Q_i}, \qquad i=1,2,3.$$

Given constant returns to scale, $\Theta_{K_i} + \Theta_{L_i} = 1$ (i=1,2,3).

By definition,

$$(3\text{-}3\text{-}12)\quad \frac{d(K_i/L_i)}{K_i/L_i} \equiv -\sigma_i \cdot \frac{d(P^*_{K_i}/P_{L_i})}{P^*_{K_i}/P_{L_i}}, \qquad i=1,2,3$$

<u>where</u>: σ_i is the elasticity of substitution between capital and labour in Sector i. Its presumptive sign is positive.

Evaluating (3-3-12) for each Sector produces, on using (3-3-5), (3-3-6):

$$(3\text{-}3\text{-}13)^*\quad \frac{dK_i}{K_i} - \frac{dL_i}{L_i} = -\sigma_i \frac{(dP_{K_i} + dT_{K_i})}{P^*_{K_i}}, \qquad i=1,2,3.$$

From Euler's theorem on linear homogeneous functions, competitive profit maximization generates:

$$(3\text{-}3\text{-}14)\quad P_i Q_i = P_{L_i} L_i + P^*_{K_i} K_i, \qquad i=1,2,3.$$

i.e.,

$$(3\text{-}3\text{-}15)\quad P_i Q_i = P_{L_i} L_i + [P_{K_i} + T_{K_i} + (m_i+\delta_i) q_i] K_i, \qquad i=1,2,3.$$

Hence, the total value of Sector i output is made up of payments to labour, $P_{L_i}L_i$, taxes on capital, $T_{K_i}K_i$, the after-tax net-value-added due to capital, $P_{K_i}K_i$, and the expenses, $(m_i+\delta_i)q_iK_i$. Total differentiation of (3-3-14) yields, on using (3-3-5):

$$(3\text{-}3\text{-}16) \quad P_i dQ_i + Q_i dP_i = dL_i + P^*_{K_i} dK_i + K_i dP^*_{K_i}\,, \qquad i=1,2,3.$$

Further, competitive profit maximization implies:

$$(3\text{-}3\text{-}17) \quad P_i dQ_i = P^*_{K_i} dK_i + dL_i\,, \qquad i=1,2,3.$$

Combining (3-3-16), (3-3-17) generates, on using (3-3-6):

$$(3\text{-}3\text{-}18)^* \quad dP_i = \frac{K_i}{Q_i}.dP^*_{K_i} = \frac{K_i}{Q_i}(dP_{K_i} + dT_{K_i})\,, \qquad i=1,2,3.$$

Total income available for spending by consumers, including government, (denoted M) is defined:

$$(3\text{-}3\text{-}19) \quad M \equiv \sum_{i=1}^{3} M_{K_i} + \sum_{i=1}^{3} T_{K_i}K_i + \sum_{i=1}^{3} P_{L_i}L_i.$$

Recalling (3-1-6), the term $\sum_{i=1}^{3} M_{K_i}$ is made up of the total after-tax net-value-added due to capital, plus the value of capital gains, $\sum_{i=1}^{3} \hat{\Theta}_i q_i K_i$. In consequence, on using (3-3-15):

$$(3\text{-}3\text{-}20) \quad M \equiv \sum_{i=1}^{3} \{P_iQ_i - (m_i+\delta_i)q_iK_i + \hat{\Theta}_i q_i K_i\}$$

$$\equiv \sum_{i=1}^{3} \{P_iQ_i - (m_i+\delta_i-\hat{\Theta}_i)q_iK_i\}.$$

The income M is available for spending on final (as distinct from intermediate) output. It is assumed that all individuals, and government have identical consumption patterns. Aggregate final consumption demand for Sector i output (denoted D_i) is represented by:

$$(3\text{-}3\text{-}21) \quad D_i = D_i(P_1, P_2, P_3, M), \qquad i=1,2,3.$$

Total differentiation of (3-3-21), logarithmically, for commodities 1 and 2, reveals:

$$(3\text{-}3\text{-}22) \quad \frac{dD_i}{D_i} = \sum_{j=1}^{3} \eta_{ij}^{D} \frac{dP_j}{P_j} + \frac{\partial D_i/\partial M}{D_i} \cdot dM, \qquad i=1,2.$$

<u>where</u>: η_{ij}^{D} is the elasticity of demand for Sector i output with respect to the price of commodity j.

Writing M as:

$$(3\text{-}3\text{-}23) \quad M \equiv \sum_{j=1}^{3} (P_{K_j} + \hat{\theta}_j q_j) K_j + \sum_{j=1}^{3} T_{K_j} K_j + \sum_{j=1}^{3} P_{L_j} L_j,$$

permits, on using (3-3-5), (3-3-6), (3-3-7):

$$(3\text{-}3\text{-}24) \quad dM = \sum_{j=1}^{3} [(P_{K_j} + \hat{\theta}_j q_i) dK_j + K_j dP_{K_j}] + \sum_{j=1}^{3} [T_{K_j} dK_j + K_j dT_{K_j}].$$

(3-3-24) in (3-3-22) gives:

$$(3\text{-}3\text{-}25)^* \quad \frac{dD_i}{D_i} = \sum_{j=1}^{3} \eta_{ij} \frac{dP_j}{P_j} + \frac{\partial D_i/\partial M}{D_i} \{ \sum_{j=1}^{3} [(P_{K_j} + \hat{\theta}_j q_j) dK_j$$

$$+ K_j dP_{K_j}] + \sum_{j=1}^{3} [T_{K_j} dK_j + K_j dT_{K_j}] \}, \qquad i=1,2.$$

Examination of the system of equations so far, reveals 16 unknowns: dD_1/D_1, dD_2/D_2, dS_1/S_1, dS_2/S_2,

dK_1/K_1, dK_2/K_2, dK_3/K_3, dL_1/L_1, dL_2/L_2, dL_3/L_3, dP_{K_1}, dP_{K_2}, dP_{K_3}, dP_1/P_1, dP_2/P_2, dP_3/P_3. The equations asterisked above represent 12 linear independent equations in these unknowns. To close the system, use is made of the equilibrium conditions for product and factor markets:

$$D_i = S_i \, , \qquad i=1,2.$$

and

$$P_{K_1} + \hat{\theta}_1 q_1 = P_{K_2} + \hat{\theta}_2 q_2 = P_{K_3} + \hat{\theta}_3 q_3.$$

These conditions provide:

(3-3-26)* $$\frac{dD_i}{D_i} = \frac{dS_i}{S_i} \, , \qquad i=1,2.$$

and, on using (3-3-6),

(3-3-27)* $$dP_{K_1} = dP_{K_2} = dP_{K_3} (=dP_K).$$

(3-3-26)* and (3-3-27)* each represent an additional two independent equations, with which to close the system. It is convenient, in what follows, to introduce the normalization that

(3-3-28) $$P_{K_i} + \hat{\theta}_i q_i = 1. \qquad i=1,2,3.$$

Substitution permits the model to be reduced to three linear independent equations in three endogenous variables (unknowns), dK_1/K_1, dK_2/K_2, and $dP_{K_1} = dP_{K_2} = dP_{K_3} = dP_K$. Algebraic solutions for each of these variables are obtained using Cramer's Rule. Solutions for all other endogenous variables can then be obtained by substitution.

It is convenient to define:

$$\phi_{K_i} \equiv (P_{K_i} + \hat{\Theta}_i q_i) K_i / M \,, \qquad i=1,2,3.$$

$$\phi_K \equiv \frac{\sum_i (P_{K_i} + \hat{\Theta}_i q_i) K_i}{M} = \sum_i \phi_{K_i}$$

ϕ_{K_i} is the share of private after-tax income from capital employed in Sector i in total income; ϕ_K is the share of total private after-tax capital income in total income.

The first two linear equations in dK_1/K_1, dK_2/K_2, dP_K, are obtained as follows: (3-3-18), (3-3-28), (3-3-27), (3-3-7), in (3-3-25) generates:

$$\text{(3-3-29)} \quad \frac{dD_i}{D_i} = \sum_{j=1}^{3} \eta^D_{ij} \frac{\Theta_{K_j}}{P^*_{K_j}} (dP_K + dT_{K_j}) + \eta^M_i \{ dP_K \cdot \phi_K + \sum_{j=1}^{3} (T_{K_j} \cdot \frac{dK_j}{K_j} \phi_{K_j} + \phi_{K_j} dT_{K_j}) \}, \qquad i=1,2.$$

<u>where</u>: η^M_i is the income elasticity of demand for the final output of Sector i.

On the supply side: (3-3-13), (3-3-18) in (3-3-8) gives:

$$\text{(3-3-30)} \quad \frac{dS_i}{S_i} = \left[\frac{1}{1 - \sum_{j=1}^{3} \Theta^E_{ji}} \right] \{ (dP_K + dT_{K_i}) \left(\frac{\Theta_{L_i} \sigma_i}{P^*_{K_i}} + \frac{\Theta_{K_i} \sum_{j=1}^{3} \Theta^E_{ji}}{P^*_{K_i}} \right) - \sum_{j=1}^{3} \Theta^E_{ji} \frac{dK_j}{K_j} + \frac{dK_i}{K_i} \}, \qquad i=1,2.$$

Combining (3-3-29), (3-3-30), and (3-3-26) produces, on using (3-3-7), (3-3-28):

$$(3\text{-}3\text{-}31)^{*}\quad dP_k\{\sum_{j=1}^{3}\eta^D_{ij}\frac{\Theta_{K_j}}{P^*_{K_j}}+\eta^M_i\phi_K-\left[\frac{1}{1-\sum_{j=1}^{3}\Theta^E_{ji}}\right]\left[\frac{\Theta_{L_i}\sigma_i}{P^*_{K_i}}+\frac{\Theta_{K_i}\sum_{j=1}^{3}\Theta^E_{ji}}{P^*_{K_i}}\right]\}$$

$$-\frac{dK_i}{K_i}\left[\frac{1}{1-\sum_{j=1}^{3}\Theta^E_{ji}}\right]+\frac{dK_1}{K_1}\{\eta^M_i\Theta_{K_1}(T_{K_1}-T_{K_3})+(\Theta^E_{1i}-\frac{\phi_{K_1}}{\phi_{K_3}}\Theta^E_{3i})\left[\frac{1}{1-\sum_{j=1}^{3}\Theta^E_{ji}}\right]\}$$

$$+\frac{dK_2}{K_2}\{\eta^M_i\Theta_{K_2}(T_{K_2}-T_{K_3})+(\Theta^E_{2i}-\frac{\phi_{K_2}}{\phi_{K_2}}\Theta^E_{3i})\left[\frac{1}{1-\sum_{j=1}^{3}\Theta^E_{ji}}\right]\}$$

$$=-\{\sum_{j=1}^{3}(\eta^D_{ij}\frac{\Theta_{K_j}}{P^*_{K_j}}+\eta^M_i\phi_{K_j})dT_{K_j}-\left[\frac{1}{1-\sum_{j=1}^{3}\Theta^E_{ji}}\right]\left[\frac{\Theta_{L_i}\sigma_i}{P^*_{K_i}}+\frac{\Theta_{K_i}\sum_{j=1}^{3}\Theta^E_{ji}}{P^*_{K_i}}\right]dT_{K_i}\},$$

$$i=1,2.$$

(3-3-31) presents the first two equations. The third is obtained as follows: (3-3-13) provides:

$$dL_i = \frac{L_i dK_i}{K_i} + \frac{\sigma_i(dP_{K_i}+dT_{K_i})L_i}{P^*_{K_i}}.$$

Hence, on using (3-3-7), (3-3-27),

$$(3\text{-}3\text{-}32)\qquad \sum_{i=1}^{3}dL_i=0=\sum_{i=1}^{3}L_i\frac{dK_i}{K_i}+dP_K\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}+\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}dT_{K_i}\ .$$

But from (3-3-7),

$$\sum_{i=1}^{3}L_i\frac{dK_i}{K_i}=\frac{dK_1}{K_1}(\frac{L_1}{K_1}-\frac{L_3}{K_3})K_1+\frac{dK_2}{K_2}(\frac{L_2}{K_2}-\frac{L_3}{K_3})K_2,$$

so that (3-3-32) is:

$$(3\text{-}3\text{-}33)^* \quad dP_K \sum_{i=1}^{3} \frac{\sigma_i L_i}{P^*_{K_i}} + \frac{dK_1}{K_1}\left(\frac{L_1}{K_1} - \frac{L_3}{K_3}\right)K_1 + \frac{dK_2}{K_2}\left(\frac{L_2}{K_2} - \frac{L_3}{K_3}\right)K_2$$

$$= -\sum_{i=1}^{3} \frac{\sigma_i L_i}{P^*_{K_i}} dT_{K_i} \quad .$$

The three equations are the two in (3-3-31), and equation (3-3-33).

To simplify notation, define:

$$A_i \equiv \sum_{j=1}^{3} B_{ij} \, , \qquad i=1,2,$$

where $B_{ij} \equiv \eta^D_{ij}\Theta_{K_j}/P^*_{K_j} + \eta^M_i \phi_{K_j}$, $\qquad i=1,2; \; j=1,2,3.$

Further, define:

$$C_i \equiv J_i \left[\frac{\Theta_{L_i}\sigma_i}{P^*_{K_i}} + \frac{\Theta_{K_i} \sum_{j=1}^{3} \Theta^E_{ji}}{P^*_{K_i}} \right] , \qquad i=1,2,$$

$$F_{ij} \equiv \eta^m_i \phi_{K_j}(T_{K_j} - T_{K_3}) + J_i\left(\Theta^E_{ji} - \frac{\phi_{K_j}}{\phi_{K_3}}\Theta^E_{3i}\right) , \text{[19]}. \qquad i,j=1,2,$$

where $J_i \equiv \left[\dfrac{1}{1 - \sum_{j=1}^{3} \Theta^E_{ji}} \right]$ $\qquad i=1,2.$

In matrix notation, (3-3-31), (3-3-33) are:

$$(3\text{-}3\text{-}34)^* \begin{bmatrix} (A_1 - C_1) & F_{11} - J_1 & F_{12} \\ (A_2 - C_2) & F_{21} & F_{22} - J_2 \\ \sum_{i=1}^{3} \frac{{}_iL_i}{P^*_{K_i}} & K_1\left(\frac{L_1}{K_1} - \frac{L_3}{K_3}\right) & K_2\left(\frac{L_2}{K_2} - \frac{L_3}{K_3}\right) \end{bmatrix} \times \begin{bmatrix} dP_K \\ \frac{dK_1}{K_1} \\ \frac{dK_2}{K_2} \end{bmatrix} = \begin{bmatrix} -\{\sum_{j=1}^{3} B_{1j} dT_{K_j} - C_1 dT_{K} \\ -\{\sum_{j=1}^{3} B_{2j} dT_{K_j} - C_2 dT_{K} \\ -\sum_{j=1}^{3} \frac{\sigma_i L_i}{P^*_{K_i}} dT_{K_i} \end{bmatrix}$$

The determinant of the matrix of coefficients is:

$$(3\text{-}3\text{-}35)\quad D \equiv (A_1-C_1)\{F_{21}K_2(\frac{L_2}{K_2}-\frac{L_3}{K_3})-(F_{22}-J_2)K_1(\frac{L_1}{K_1}-\frac{L_3}{K_3})\}$$

$$+(A_2-C_2)\{F_{12}K_1(\frac{L_1}{K_1}-\frac{L_3}{K_3})-(F_{11}-J_1)K_2(\frac{L_2}{K_2}-\frac{L_3}{K_3})\}$$

$$+\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}\{(F_{11}-J_1)(F_{22}-J_2)-F_{12}F_{21}\}$$

The algebraic solution for dP_K is

$$(3\text{-}3\text{-}36)\quad dP_K = \frac{\begin{aligned}&-\{\sum_{j=1}^{3}B_{1j}dT_{K_j}-C_1dT_{K_1}\}\{F_{21}K_2(\frac{L_2}{K_2}-\frac{L_3}{K_3}) \\ &-(F_{22}-J_2)K_1(\frac{L_1}{K_1}-\frac{L_3}{K_3})\}-\{\sum_{j=1}^{3}B_{2j}dT_{K_j}-C_2dT_{K_2}\} \\ &\{F_{12}K_1(\frac{L_1}{K_1}-\frac{L_3}{K_3})-(F_{11}-J_1)K_2(\frac{L_2}{K_2}-\frac{L_3}{K_3})\} \\ &-\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}.dT_{K_i}\{(F_{11}-J_1)(F_{22}-J_2)-F_{12}F_{21}\}\end{aligned}}{D}$$

Hence, the change in the net price of capital (which answers the incidence question) due to changes in the policy instruments, dT_{K_i}, depends upon factor shares, factor intensities and absolute factor employments, elasticities of substitution, own-price and cross-price elasticities of demand for final outputs, the income elasticities of demand for final outputs, the size of the unit tax changes and the differences among tax rates in different sectors. The incidence equation is valid for the analysis of taxes of finite size; and it is not necessary that initial taxes be zero, nor (even) that they be neutral. Each of these features amounts to a significant improvement on the usual Harberger-type models. Equation (3-3-36) is much more complex than the incidence equation found in the usual Harberger-type models, however. There are two main reasons for this: Firstly, this is a three-sector (rather than a two-sector) model. And secondly, the present formulation explicitly allows for taxes of finite size.

Use of equation (3-3-36) in conjunction with (3-3-18) permits an examination of the effects of tax changes on output prices, permitting an examination of tax incidence on the uses, as well as the sources, side of the budget.

Use of Cramer's Rule on (3-3-34) also permits solution of the system for dK_1/K_1 and dK_2/K_2. Then, on using (3-3-7), the solution for dK_2 is obtained. For dK_1/K_1, Cramer's Rule produces:

$$(3\text{-}3\text{-}37)\quad \frac{dK_1}{K_1} = \frac{\begin{aligned}&-\{\sum_{j=1}^{3} B_{2j}dT_{K_j} - C_2 dT_{K_2}\}\{(A_1-C_1)K_2(\frac{L_2}{K_2} - \frac{L_3}{K_3})\\ &-F_{12}\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}\} - \{\sum_{j=1}^{3} B_{1j}dT_{K_j} - C_1 dT_{K_1}\}\\ &\{(F_{22}-J_2)\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}} - (A_2-C_2)K_2(\frac{L_2}{K_2} - \frac{L_3}{K_3})\}\\ &-\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}.dT_{K_i}\{(A_2-C_2)F_{12} - (A_1-C_1)(F_{22}-J_2)\}\end{aligned}}{D}$$

For dK_2/K_2:

(3-3-38) $$\frac{dK_2}{K_2} = \frac{\begin{aligned}&-\{\sum_{j=1}^{3} B_{1j}dT_{K_j} - C_1 dT_{K_1}\}\{(A_2-C_2)K_1(\frac{L_1}{K_1} - \frac{L_3}{K_3}) \\ &-F_{21}\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}\} - \{\sum_{j=1}^{3} B_{2j}dT_{K_j} - C_2 dT_{K_2}\} \\ &\{(F_{11}-J_1)\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}} - (A_1-C_1)K_1(\frac{L_1}{K_1} - \frac{L_3}{K_3})\} \\ &-\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}.dT_{K_i}\{(A_1-C_1)F_{21} - (A_2-C_2)(F_{11}-J_1)\}\end{aligned}}{D}$$

A similar equation for dK_3/K_3 can easily be obtained on application of (3-3-7) to (3-3-37), (3-3-38). From each of these equations, the "reduced form coefficients", $\partial K_i/\partial T_{K_j}$ (i,j=1,2,3), are derived. It seems natural to refer to these coefficients as "tax multipliers". They summarize both the impact and feedback effects of tax changes on the allocation of capital. The first tax multiplier, $\partial K_1/\partial T_{K_1}$, is derived from (3-3-37):

(3-3-39) $$\frac{\partial K_1}{\partial T_{K_1}} = \frac{-K_1\left[\begin{aligned}&B_{21}\{(A_1-C_1)K_2(\frac{L_2}{K_2} - \frac{L_3}{K_3}) - F_{12}\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}\} \\ &+ (B_{11}-C_1)\{(F_{22}-J_2)\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}} - (A_2-C_2)K_2(\frac{L_2}{K_2} - \frac{L_3}{K_3}) \\ &+\frac{\sigma_1 L_1}{P^*_{K_1}}\{(A_2-C_2)F_{12} - (A_1-C_1)(F_{22}-J_2)\}\end{aligned}\right]}{D}$$

The multiplier, $\partial K_2/\partial T_{K_2}$, is derived from (3-3-38):

$$(3\text{-}3\text{-}40)\quad \frac{\partial K_2}{\partial T_{K_2}} = \frac{-K_2\left[B_{12}\{(A_2-C_2)K_1(\frac{L_1}{K_1}-\frac{L_3}{K_3})-F_{21}\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}\} + (B_{22}-C_2)\{(F_{11}-J_1)\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}-(A_1-C_1)K_1(\frac{L_1}{K_1}-\frac{L_3}{K_3})\} + \frac{\sigma_2 L_2}{P^*_{K_2}}\{(A_1-C_1)F_{21}-(A_2-C_2)(F_{11}-J_1)\}\right]}{D}$$

The multiplier, $\partial K_3/\partial T_{K_3}$, is obtained by using (3-3-37) and (3-3-38) in (from (3-3-7)):

$$dK_3 = -K_1(\frac{dK_1}{K_1})-K_2(\frac{dK_2}{K_2}).$$

This multiplier is:

$$(3\text{-}3\text{-}41)\quad \frac{\partial K_3}{\partial T_{K_3}} = \frac{K_1\left[B_{23}\{(A_1-C_1)K_2(\frac{L_2}{K_2}-\frac{L_3}{K_3})-F_{12}\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}\} \; B_{13}\{(F_{22}-J_2)\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}-(A_2-C_2)K_2(\frac{L_2}{K_2}-\frac{L_3}{K_3})\} + \frac{\sigma_3 L_3}{P^*_{K_3}}\{(A_2-C_2)F_{12}-(A_1-C_1)(F_{22}-J_2)\}\right] + K_2\left[B_{13}\{(A_2-C_2)K_1(\frac{L_1}{K_1}-\frac{L_3}{K_3})-F_{21}\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}\} \; B_{23}\{(F_{11}-J_1)\sum_{i=1}^{3}\frac{\sigma_i L_i}{P^*_{K_i}}-(A_1-C_1)K_1(\frac{L_1}{K_3}-\frac{L_3}{K_3})\} + \frac{\sigma_3 L_3}{P^*_{K_3}}\{(A_1-C_1)F_{21}-(A_2-C_2)(F_{11}-J_1)\}\right]}{D}$$

The multipliers (3-3-39), (3-3-40), and (3-3-41) compare with the Ott and Ott (1973) "assumption" that

$$\frac{\partial K_i}{\partial T_{K_i}} = \frac{\partial K_i}{\partial P^*_{K_i}}, \qquad i=1,2,3. \tag{3-3-42}$$

i.e., that $\partial P^*_{K_i}/\partial T_{K_i} = 1$: An increase in the unit tax rate T_{K_i} produces an equal increase in the gross (unit) rental price of capital, with no affect on net rental prices. Clearly, the questions of tax shifting and tax incidence cannot be explored in models which employ this restrictive assumption.[20]

Estimates for each of the cross-partial derivatives

$$\frac{\partial K_i}{\partial T_{K_j}}, \qquad i,j=1,2,3;i\neq j,$$

might be derived from (3-3-37), (3-3-38). However, it is simpler to employ the adding-up property, due to fixed factor supplies, that

$$\sum_i \frac{\partial K_i}{\partial T_{K_j}} = 0, \qquad j=1,2,3 \tag{3-3-43}$$

and the symmetry of cross-substitution effects; i.e.,

$$\frac{\partial K_i}{\partial T_{K_j}} = \frac{\partial K_j}{\partial T_{K_i}}, \qquad i,j=1,2,3. \tag{3-3-44}$$

The first of these conditions simply says that when capital is in fixed supply, a change in the tax rate on capital in any Sector j can only reallocate the existing stock of capital. The second of these conditions is not so obvious, although it appears (sometimes implicitly) in nearly every analysis of the welfare costs of the taxation of capital.[21] An intuitive explanation of this condition might proceed as follows.[22] For simplicity, consider a two-sector model with no taxes initially. The government imposes a tax of T_{K_1} on capital employed in Sector 1, and then follows this with a tax of T_{K_2} on capital employed in Sector 2. The tax T_{K_1} raises

$$T_{K_1}(K_1+\frac{\partial K_1}{\partial T_{K_1}}.T_{K_1})$$

in revenue. The tax T_{K_2} raises

$$T_{K_2}(K_2+\frac{\partial K_2}{\partial T_{K_2}}.T_{K_2})+T_{K_1}(\frac{\partial K_1}{\partial T_{K_2}}.T_{K_2})$$

in revenue. The term $T_{K_1}(\frac{\partial K_1}{\partial T_{K_2}}.T_{K_2})$ is the addition to revenue (conceivably negative) derived from Sector 1 when the tax T_{K_2} is imposed. Total tax revenue is

$$\bar{T}_1=T_{K_1}(K_1+\frac{\partial K_1}{\partial T_{K_1}}.T_{K_1})+T_{K_2}(K_2+\frac{\partial K_2}{\partial T_{K_2}}.T_{K_2})+T_{K_1}(\frac{\partial K_1}{\partial T_{K_2}}.T_{K_2})$$

$$=T_{K_1}K_1+\frac{\partial K_1}{\partial T_{K_1}}.T_{K_1}^2+T_{K_2}K_2+\frac{\partial K_2}{\partial T_{K_2}}T_{K_2}^2+\frac{\partial K_1}{\partial T_{K_2}}.T_{K_1}T_{K_2}.$$

Alternatively, suppose the government imposes the tax T_{K_2} first, and the tax T_{K_1} second. Then, total revenue is

$$\bar{T}_2=T_{K_2}(K_2+\frac{\partial K_2}{\partial T_{K_2}}.T_{K_2})+T_{K_1}(K_1+\frac{\partial K_1}{\partial T_{K_1}}.T_{K_1})+T_{K_2}(\frac{\partial K_2}{\partial T_{K_1}}.T_{K_1})$$

$$=T_{K_2}K_2+\frac{\partial K_2}{\partial T_{K_2}}.T_{K_2}^2+T_{K_1}K_1+\frac{\partial K_1}{\partial T_{K_1}}.T_{K_1}^2+\frac{\partial K_2}{\partial T_{K_1}}.T_{K_2}T_{K_1}$$

Now, in this comparative static world, the total revenue raised by the government, from a system of taxes, should be independent of the order in which those taxes are imposed. But this requires that $\overline{T}_1 = \overline{T}_2$, which can be true only if $\partial K_1/\partial T_{K_2} = \partial K_2/\partial T_{K_1}$.

(3-3-43) and (3-3-44) can be used to produce three linear independent equations in $\partial K_1/\partial T_{K_2} = \partial K_2/\partial T_{K_1}$, $\partial K_1/\partial T_{K_3} = \partial K_3/\partial T_{K_1}$, $\partial K_2/\partial T_{K_3} = \partial K_3/\partial T_{K_2}$. These equations can be written:

$$(3\text{-}3\text{-}45)\qquad \frac{\partial K_1}{\partial T_{K_2}} = \frac{\partial K_2}{\partial T_{K_1}} = \frac{\partial K_3/\partial T_{K_3} - \partial K_1/\partial T_{K_1} - \partial K_2/\partial T_{K_2}}{2},$$

$$(3\text{-}3\text{-}46)\qquad \frac{\partial K_1}{\partial T_{K_3}} = \frac{\partial K_3}{\partial T_{K_1}} = \frac{\partial K_2/\partial T_{K_2} - \partial K_1/\partial T_{K_1} - \partial K_3/\partial T_{K_3}}{2},$$

$$(3\text{-}3\text{-}47)\qquad \frac{\partial K_2}{T_{K_3}} = \frac{\partial K_3}{T_{K_2}} = \frac{\partial K_1/\partial T_{K_1} - \partial K_2/\partial T_{K_2} - \partial K_3/\partial T_{K_3}}{2},$$

In view of the solutions for each of dK_1, dK_2, dK_3, write

$$(3\text{-}3\text{-}48)\qquad dK_i = \sum_{j=1}^{3} \frac{\partial K_i}{\partial T_{K_j}} . dT_{K_j}, \qquad i=1,2,3.$$

The equations (3-3-39), (3-3-40), (3-3-41), (3-3-45), (3-3-46), (3-3-47), and (3-3-48) can be used to calculate the distortions in the allocation of capital among sectors, due to a set of tax changes dT_{K_j} (j=1,2,3). The measure of distortion is valid whether the initial set of taxes is neutral or non-neutral. (In particular, initial taxes need not be zero.) For this reason, the model presented here can be used to analyse the effects of introducing a distortionary tax policy in an economy which is already distorted by a set of non-neutral taxes. This useful property is not enjoyed by any of the previous Harberger-type analyses of tax incidence.

The model can be specialized to consider the distortions created by a move from a system of neutral taxes to the present system of non-neutral taxation. This specialization affects nothing in the model so far; it merely permits an alternative form of (3-3-48) to be derived: Associated with a neutral tax system there is a unit tax (i.e., tax per unit of capital $T^N_{K_i}$ on capital employed in Sector i. There is no need for $T^N_{K_i}$ to be zero (which is the restrictive assumption made by Harberger (1962), (1966)), but it will be the same in each sector if unit net incomes (income per unit of capital) are equalized among sectors, and if there are no other non-neutral taxes in the economy. (3-3-48) can be specialized to obtain:

$$\text{(3-3-49)} \quad dK_i = K_i - K_i^N = \sum_{j=1}^{3} \frac{\partial K_i}{\partial T_{K_j}} . (T_{K_j} - T^N_K)$$

$$= \sum_{j=1}^{3} \frac{\partial K_i}{\partial T_{K_j}} . T_{K_j} - \sum_{j=1}^{3} \frac{\partial K_i}{\partial T_{K_j}} . T^N_{K_j} , \qquad i=1,2,3.$$

<u>where</u>: T_{K_j} is the present actual unit tax on capital in Sector j.

K_i is the capital stock employed in Sector i under the present tax system.

K_i^N is the stock of capital employed in Sector i under neutrality.

The assumption of a fixed total supply of capital ensures that taxation induced distortions are reflected in changes in the allocation of capital, with no change in the total stock of capital. Now, if a set of unit taxes $T_{K_j}^N$ is neutral, and if the total capital stock is in completely inelastic supply, then by definition the taxes $T_{K_j}^N$ must produce the same equilibrium allocation of capital to each sector as if all the T_{K_j} were zero. Hence,

$$(3\text{-}3\text{-}50) \qquad K_i^N - K_i\,(T_{K_j}=0, j=1,2,3) = \sum_{j=1}^{3} \frac{\partial K_i}{\partial T_{K_j}} \cdot T_{K_j}^N - \sum_{j=1}^{3} \frac{\partial K_i}{\partial T_{K_j}}(0) = 0,$$

i.e.,

$$(3\text{-}3\text{-}51) \qquad \sum_{j=1}^{3} \frac{\partial K_i}{\partial T_{K_j}} \cdot T_{K_j}^N = 0,$$

(3-3-51) in (3-3-49) produces:

$$(3\text{-}3\text{-}52) \qquad dK_i = \sum_{j=1}^{3} \frac{\partial K_i}{\partial T_{K_j}} \cdot T_{K_j}\ , \qquad i=1,2,3.$$

This is the measure of distortion suggested in Harberger (1964a.), and employed by Ott and Ott (1973).

The model, as it has been developed so far, is quite general in the sense that it can be employed to analyse tax-induced distortions in a variety of interesting contexts. In this thesis, the model is specialized to consider the general equilibrium implications of the favourable tax treatment of owner-occupied housing. This context simplifies the expressions A_i, B_{ij}, C_i, and F_{ij}, employed in the tax-incidence multipliers derived above. There is virtually no labour income in the output of housing, whether owner-occupied or rented.[23.] In view of this, applications of the model set the share of capital in the outputs of owner-occupied and rented housing equal to unity. A further simplification arises because all of the output of both owner-occupied and rented housing is for final consumption; put another way, the whole of the intermediate expenditure on capital employed in all three sectors is for output produced in the non-residential sector. To see the importance of these simplifications, denote

Sector 1: Owner-Occupied Housing

Sector 2: Rented Housing

Sector 3: Other Industry

Then,

$$L_1=L_2=\Theta_{L1}=\Theta_{L2}= 0$$

$$a_{11}=a_{21}=a_{31}=a_{12}=a_{22}=a_{32}=0; \; a_{13}=a_{23}=a_{33}=1.$$

$$\Theta^E_{11}=\Theta^E_{21}=\Theta^E_{31}=\Theta^E_{12}=\Theta^E_{22}=\Theta^E_{32}=0;$$

$$\theta^E_{13}=\frac{q_1K_1(m_1+\delta_1-\hat{\theta}_1)}{P_3Q_3}$$

$$\theta^E_{23}=\frac{q_2K_2(m_2+\delta_2-\hat{\theta}_2)}{P_3Q_3}$$

$$\theta^E_{33}=\frac{q_3K_3(m_3+\delta_3-\hat{\theta}_3)}{P_3Q_3}$$

$$C_1=C_2=0$$

$$F_{ij}=\eta^M_i\phi_{K_j}(T_{K_j}-T_{K_3}), \qquad i,j=1,2.$$

Even with these simplifications, however, there are a large number of parameters in the measure of distortion (3-3-52), which need to be estimated in order to apply the model developed here. In applying the model in Chapter 4, some of the parameter value estimates employed have been taken from independent estimates provided by (among others) Laidler (1969) and Lee (1964). But an equal number of parameter values are obtained by inference: The general equilibrium structure of the model permits six parameter values to be inferred from independent estimates of the other six parameter values. The procedure adopted is detailed below.

Estimates for η^D_{11}, η^D_{22}, η^M_1, η^M_2, σ_3 are obtained from independent sources. To derive the other parameters (with the exception of η^D_{33}), define the share of spending on Sector i final output, in total final spending, as:

$$\text{(3-3-53)} \qquad \alpha_i \equiv \frac{P_iD_i}{M} = \frac{P_iQ_i(1-\sum_{j=1}^{3}\theta^E_{ji})}{M}, \qquad i=1,2,3.$$

It can be shown that

$$(3\text{-}3\text{-}54) \qquad \sum_{i=1}^{3} \alpha_i \eta_i^M = 1.$$

Hence, since values of η_1^M, η_2^M are known, independently, estimates for η_3^M are easily derived on using (3-3-53) and (3-3-54). The remaining parameters are η_{12}^D, η_{21}^D, η_{13}^D, η_{31}^D, η_{23}^D, η_{32}^D, η_{33}^D. Using the property that demand functions are homogeneous of degree zero, permits three equations in these seven unknowns to be derived:

$$(3\text{-}3\text{-}55) \qquad \sum_{j=1}^{3} \eta_{ij}^D + \eta_i^M = 0, \qquad i=1,2,3.$$

A further three equations in these unknowns are obtained from the Slutsky equation, as follows:[24.] The Slutsky equation might be written:

$$(3\text{-}3\text{-}56) \qquad \frac{\partial D_i}{\partial P_j} = \left(\frac{\partial D_i}{\partial P_j}\right)_{u\ \text{const.}} - D_j \frac{\partial D_i}{\partial M}, \qquad i,j=1,2,3,$$

<u>where</u>: $\left(\frac{\partial D_i}{\partial P_j}\right)_{u\ \text{const.}}$ is the compensated cross-substitution term.

But the Slutsky equation might also be written:

$$(3\text{-}3\text{-}57) \qquad \frac{\partial D_j}{\partial P_i} = \left(\frac{\partial D_j}{\partial P_i}\right)_{u\ \text{const.}} - D_i \cdot \frac{\partial D_j}{\partial M}, \qquad i,j=1,2,3.$$

In addition, it is well-known that the cross-substitution terms exhibit symmetry,[25.] so that:

$$(3\text{-}3\text{-}58)\qquad \left(\frac{\partial D_i}{\partial P_j}\right)_{u\ \text{const.}} = \left(\frac{\partial D_j}{\partial P_i}\right)_{u\ \text{const.}}$$

Hence, on combining (3-3-56), (3-3-57), (3-3-58):

$$(3\text{-}3\text{-}59)\qquad \frac{\partial D_i}{\partial P_j} + D_j.\frac{\partial D_i}{\partial M} = \frac{\partial D_j}{\partial P_i} + D_i.\frac{\partial D_j}{\partial M}.$$

i.e.

$$(3\text{-}3\text{-}60)\qquad \eta^D_{ij}.\frac{D_i}{P_j}+\frac{D_iD_j}{M}.\eta^M_i = \eta^D_{ji}.\frac{D_j}{P_i}+\frac{D_jD_i}{M}.\eta^M_j, \qquad i,j=1,2,3.$$

(3-3-60) can be rearranged to yield:

$$(3\text{-}3\text{-}61)\qquad \eta^D_{ij}=\frac{P_jD_j}{P_iD_i}.\eta^D_{ji}+\frac{P_jD_j}{M}(\eta^M_j-\eta^M_i), \qquad i,j=1,2,3.$$

Now, in equilibrium, with no savings, $P_jD_j/P_iD_i = \alpha_j/\alpha_i$, and $P_jD_j/M=\alpha_j$. Hence, in equilibrium

$$(3\text{-}3\text{-}62)\qquad \eta^D_{ij} = \frac{\alpha_j}{\alpha_i}.\eta^D_{ji}+\alpha_j(\eta^M_j-\eta^M_i), \qquad i,j=1,2,3.$$

The three equations provided by (3-3-62) can be used together with the three equations in (3-3-55) to obtain each of the cross-price elasticities from the known values of η^D_{11}, η^D_{22}, η^M_1, η^M_2, η^M_3, and a "plausible" value of η^D_{33}.

3.4 THE BURDEN OF THE NON-NEUTRAL TAXATION OF CAPITAL.

There are two effects of the taxation of income from capital: (1) Changes in the distribution of income;

and (2) impacts on economic efficiency. The second effect is the subject of Section 3.5. The first effect relates to the incidence of taxes on capital income. This issue has been examined in some detail in earlier sections, but there is one aspect of tax incidence that has been left to this section: This is the question of tax burden. In particular, this section is concerned with the distribution of the burden of a non-neutral change in taxes on capital between the two factors of production, capital and labour, and on capital among sectors. Harberger (1962) addressed a related issue: Much of that paper is concerned with the burden of the corporation income tax.

From (3-3-23), the money value of national income can be written:

$$(3\text{-}4\text{-}1) \quad M \equiv \sum_{i=1}^{3} (P_{K_i} + \hat{\theta}_i q_i) K_i + \sum_{i=1}^{3} T_{K_i} K_i + \sum_{i=1}^{3} P_{L_i} L_i .$$

The equilibrium conditions in the capital and labour markets permit:

$$(3\text{-}4\text{-}2) \quad M = (P_K + \hat{\theta} q) \sum_{i=1}^{3} K_i + \sum_{i=1}^{3} T_{K_i} K_i + P_L \sum_{i=1}^{3} L_i$$

Dividing through (3-4-2) by P_L gives an expression for national income in terms of labour (i.e., in units of labour):

$$(3\text{-}4\text{-}3) \quad \frac{M}{P_L} = \left(\frac{P_K}{P_L} + \frac{\hat{\theta} q}{P_L}\right) \sum_{i=1}^{3} K_i + \sum_{i=1}^{3} \frac{T_{K_i} K_i}{P_L} + \sum_{i=1}^{3} L_i$$

In the present model, labour has been taken as <u>numeraire</u>, so that $P_{L_i} = P_L = 1$. Thence, the tax incidence equation for dP_K, (3-3-36), is actually an equation for $d(P_K/P_L)$. The change in national income in terms of labour, following a policy change from neutral taxation to non-neutral taxation is:

$$(3\text{-}4\text{-}4) \qquad d\left(\frac{M}{P_L}\right) = d\left(\frac{P_K}{P_L}\right) \sum_{i=1}^{3} K_i + d\left(\frac{\overline{T}_K}{P_L}\right),$$

<u>where</u>: $\left(\frac{\overline{T}_K}{P_L}\right)$ is total tax revenue from capital income, in terms of labour.

Evaluating $d(\overline{T}/P_L)$:

$$(3\text{-}4\text{-}5) \qquad d\left(\frac{\overline{T}_K}{P_L}\right) = \frac{d\overline{T}_K}{P_L} = d\overline{T}_K = \sum_{i=1}^{3} T_{K_i} K_i - T_K^N K_i .$$

Capital can be said to bear the full burden of the non-neutral taxation of capital if the net income on capital falls by the same amount as the increase in tax revenue. i.e., if $-dP_K \sum_{i=1}^{3} K_i = d\overline{T}_K$, which can be written

$$(3\text{-}4\text{-}6) \qquad dP_K = \frac{-d\overline{T}_K}{\sum_{i=1}^{3} K_i} .$$

In this case, $d(M/P_L) = 0$. Now, since labour is in fixed total supply,

$$(3\text{-}4\text{-}7) \qquad d\left[\frac{M}{P_L \sum_{i=1}^{3} L_i}\right] = \left[\frac{1}{\sum_{i=1}^{3} L_i}\right] . d\left(\frac{M}{P_L}\right) .$$

So, if $d(M/P_L = 0$, $d(M/P_L \sum_{i=1}^{3} L_i) = 0$. i.e., the share of labour in national income is unaffected by the change in tax policy.

In other cases, if $-dP_K \sum_{i=1}^{3} K_i > d\bar{T}_K$ (i.e., $-dP_K > d\bar{T}_K / \sum_{i=1}^{3} K_i$), then capital bears more than the full burden of non-neutral taxation. And if $-dP_K \sum_{i=1}^{3} K_i < d\bar{T}_K$ (i.e., $-dP_K < d\bar{T}_K / \sum_{i=1}^{3} K_i$), then capital bears less than the full burden of non-neutral taxation, with some of the burden falling on labour. In the first case, national income in terms of labour falls, and the share of labour in national income increases. i.e.,

$$d\left(\frac{M}{P_L}\right) < 0,\quad d\left[\frac{P_L \sum_{i=1}^{3} L_i}{M}\right] > 0.$$

In the second case, national income in terms of labour increases, and the share of labour in national income falls. i.e.,

$$d\left(\frac{M}{P_L}\right) > 0,\quad d\left[\frac{P_L \sum_{i=1}^{3} L_i}{M}\right] < 0.$$

If P_K/P_L is unaffected by the policy change, then, since capital and labour are each in fixed total supply,

$$\text{(3-4-8)}\quad d\left(\frac{P_K}{P_L}\right) = d\left(\frac{P_K+\hat{\theta}q}{P_L}\right) = 0 = \frac{\sum_{i=1}^{3} K_i}{\sum_{i=1}^{3} L_i} . d\left(\frac{P_K+\theta q}{P_L}\right)$$

$$= d\left[\frac{(P_K + \hat{\theta}q) \sum_{i=1}^{3} K_i/M}{P_L \sum_{i=1}^{3} L_i/M}\right]$$

This implies that the after-tax share of national income going to each factor changes by the same percentage. In this case, the burden of non-neutral taxation is shared between capital and labour in proportion to their (after-tax) shares in national income.

If labour bears the full burden of the non-neutral tax policy, then the share of the after-tax income of capital in national income must be unaffected by the policy. i.e.,

$$d\left(\frac{(P_K+\hat{\Theta}q)}{P_L}\sum_{i=1}^{3} K_i/\frac{M}{P_L}\right) = 0. \tag{3-4-9}$$

But this implies:

$$\frac{\frac{(P_K+\hat{\Theta}q)}{P_L}\sum_{i=1}^{3} K_i . d\left(\frac{M}{P_L}\right) - \left(\frac{M}{P_L}\right) d\left(\frac{P_K}{P_L}\right)\sum_{i=1}^{3} K_i}{\left[\frac{(P_K+\hat{\Theta}q)}{P_L}\sum_{i=1}^{3} K_i\right]^2} = 0. \tag{3-4-10}$$

i.e.,

$$\frac{d(M/P_L)}{M/P_L} = \frac{d(P_K/P_L)}{(P_K+\hat{\Theta}q)/P_L} \tag{3-4-11}$$

On using (3-4-4), (3-4-11) can be written as:

$$\frac{dP_K}{(P_K+\hat{\Theta}q)} = \frac{dP_K\sum_{i=1}^{3} K_i}{M} + \frac{d\overline{T}_K}{M},$$

or,

$$dP_K = \frac{(P_K+\hat{\Theta}q)\,d\overline{T}_K}{M-(P_K+\hat{\Theta}q)\sum_{i=1}^{3} K_i},$$

which, on using the normalization that $P_K+\hat{\theta}q = 1$, yields:

$$(3\text{-}4\text{-}12) \qquad dP_K = \frac{-d\overline{T}_K}{\sum_{i=1}^{3} K_i - M} .$$

This compares with (3-4-6), in which case capital bears the full burden of non-neutral taxation.

To summarize, capital bears the full burden of non-neutral taxation if (from (3-4-6))

$$(3\text{-}4\text{-}13) \qquad dP_K = \frac{-d\overline{T}_K}{\sum_{i=1}^{3} K_i} .$$

Capital bears more than the full burden of non-neutral taxation if

$$(3\text{-}4\text{-}14) \qquad dP_K < \frac{-d\overline{T}_K}{\sum_{i=1}^{3} K_i} .$$

The burden of non-neutral taxation is shared between capital and labour if

$$(3\text{-}4\text{-}15) \qquad dP_K > \frac{-d\overline{T}_K}{\sum_{i=1}^{3} K_i} ,$$

and is shared between capital and labour in (precise) proportion to their (after-tax) shares in national income if (from (3-4-8))

$$(3\text{-}4\text{-}16) \qquad dP_K = 0.$$

Finally, labour bears the full burden of non-neutral taxation of capital if (from (3-4-12))

$$(3\text{-}4\text{-}17) \qquad dP_K = \frac{-d\overline{T}_K}{\sum_{i=1}^{3} K_i - M} \cdot ^{26.}$$

The burden of the non-neutral taxation of capital can also be separated into sectoral burdens. The burden of non-neutral taxes on capital in Sector i is simply the change in the net income obtained from capital employed in that Sector. This change in net income is:

$$(3\text{-}4\text{-}18) \qquad d\{(P_{K_i}+\hat{\theta}_i q_i)K_i\} = (P_K+\theta q)dK_i + K_i^N dP_K$$

<u>where</u>: $(P_K+\hat{\theta}q)$ is the after-tax net value-added plus capital gains on one unit of capital after the disturbance, and is equal across sectors.

The total burden of the non-neutral taxation of capital is the change in the aggregate net income of capital. In this three-sector model, this burden is

$$(3\text{-}4\text{-}19) \qquad \sum_{i=1}^{3} d\{(P_{K_i}+\hat{\theta}_i q_i)K_i\} = (P_K+\hat{\theta}q)\sum_{i=1}^{3} dK_i + dP_K \sum_{i=1}^{3} K_i^N$$

$$= dP_K \sum_{i=1}^{3} K_i^N$$

A simple diagram (Figure 3-4-1) can be used to illustrate the burden of capital taxes on sectoral net incomes. This illustration employs two sectors only (a third sector is easily included, but adds nothing here). In addition, there is a fixed total stock of capital, initial neutral taxes are zero (for simplicity), a tax is imposed on capital in Sector 1 only, and net value-added plus capital gains per unit of capital ($P_{K_i}+\hat{\theta}_i q_i$) is equalised between sectors both before and after the disturbance.

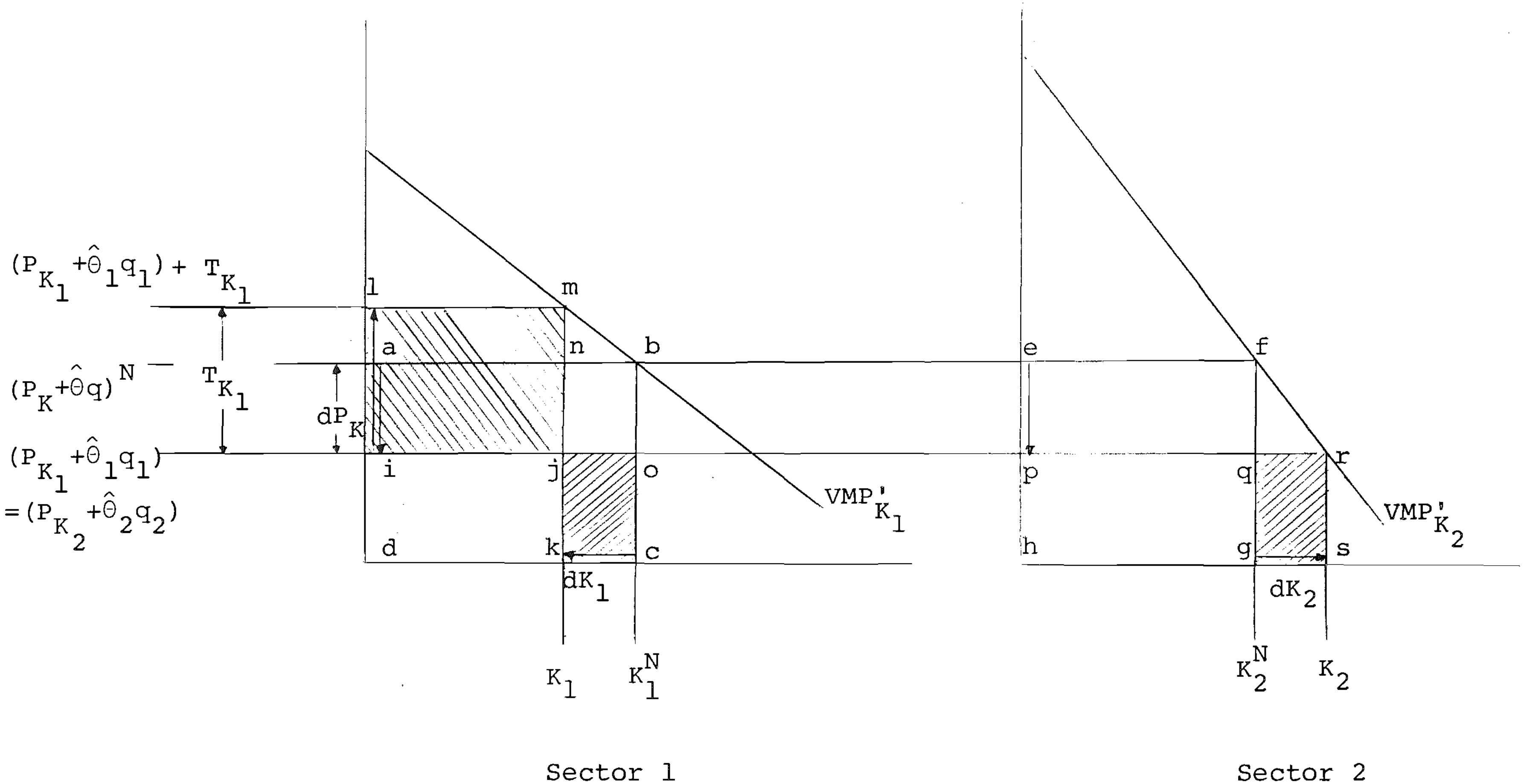
The schedules VMP'_{K_1}, VMP'_{K_2}, in Figure 3-4-1, are net productivity schedules, and are defined:

$$VMP'_{K_i} \equiv VMP_{K_i}(=P^*_{K_i})-(\delta_i+m_i-\hat{\theta}_i)q_i, \qquad i=1,2. \tag{3-4-20}$$

These schedules can be related to the VMP_{K_i} schedule of Figure 3-1-1: The schedule VMP'_{K_i} can be obtained from the schedule VMP_{K_i} by subtracting an amount E_i per unit of capital.

With no taxes on capital, equilibrium net income is $(P_K+\hat{\theta}q)^N$ per unit of capital in each sector. If a tax is imposed at a rate T_{K_1} per unit of capital in Sector 1, the net- and gross-of-tax unit incomes (i.e., income per unit of capital) are separated by this amount in Sector 1. The quantity of capital employed in Sector 1 falls by $(K_1^N-K_1)$ units, while the quantity of capital employed in Sector 2 increases by an equal amount, $(K_2-K_2^N) = (K_1^N-K_1)$. Net income on capital in Sector 1 is given by the area of the rectangle abcd before the disturbance; after the disturbance, it is ijkd. The net loss in net income is

FIGURE 3-4-1:



$$VMP'_{K_i} \equiv VMP_{K_i} - (m_i + \delta_i - \hat{\Theta}_i) q_i$$

aboi+jock=$K_1^N dP_K + (P_{K_1} + \hat{\theta}_1 q_1) dK_1$. The change in tax revenue is lmji=$T_{K_1} K_1$. Sector 2 net income before the disturbance is given by the area of the rectangle efgh; after the disturbance it is prsh. The net increase in net income is qrsg-efqp=$K_2^N dP_K + (P_{K_2} + \hat{\theta} q_2) dK_2$. Since jock=qrsg, the net reduction in aggregate net capital income is aboi+efqp $= dP_K \sum_{i=1}^{2} K_i^N$.

In terms of Figure 3-4-1, capital bears more than /precisely/less than, the full burden of the non-neutral taxation of capital if aboi+efqp$\gtreqless$lmji.

Chapter 4 employs the measures of tax burden developed here to estimate the distribution of the burden of non-neutral taxation among sectors, and between capital and labour. Estimates are derived for Australia, Canada, New Zealand, the United Kingdom, and the United States of America. In these applications it is convenient to write (3-4-18) as

$$\text{(3-4-21)} \qquad \begin{matrix}\text{Burden on}\\ \text{Sector } i\end{matrix} = dK_i + dP_K K_i^N ,$$

on using the normalization that $(P_{K_i} + \hat{\theta}_i q_i) = 1$ $(i=1,2,3)$.

3.5 THE WELFARE COSTS OF NON-NEUTRAL TAXATION OF CAPITAL.

This Section presents a measure of welfare loss associated with the distortions due to the non-neutral taxation of income from capital. The measure adopted can be found (in part) in Hotelling (1938), Corlett and Hague (1953), and in other papers, and is developed explicitly in Harberger (1964a).

The diagrammatic illustration of tax burden, developed in Section 3.4, can be modified to illustrate[27] the measurement of the efficiency cost of non-neutral taxation in a two-sector model (again, the third sector adds nothing, except complexity, here). Figure 3-5-1 has been developed for this purpose.

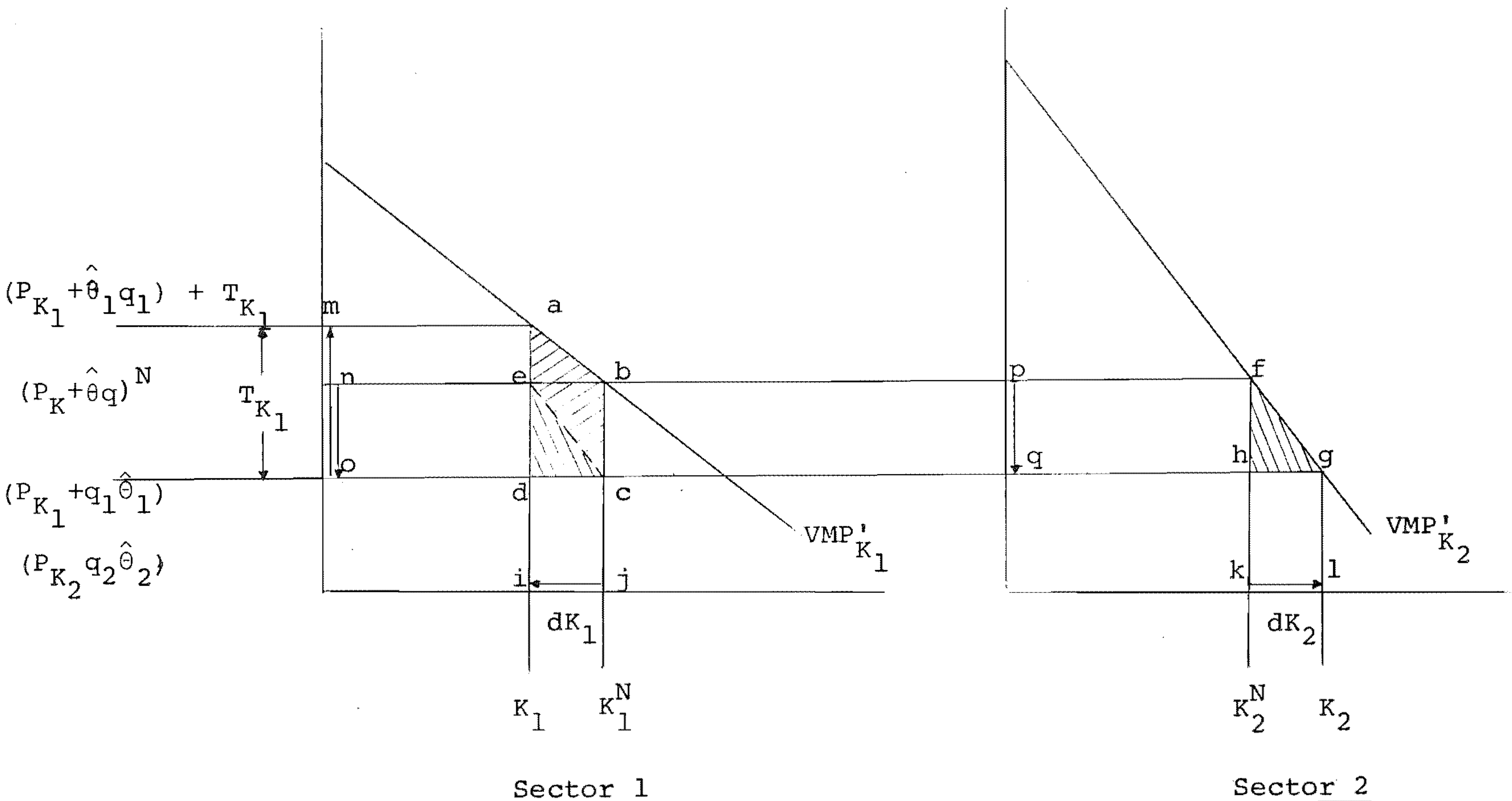
Following the imposition of a tax T_{K_1} in Sector 1, there is a transfer of capital from this sector to Sector 2. i.e., capital is transferred from the sector with the higher unit income gross-of-tax (this is the social unit rate of return) to the sector with the lower unit income. The loss in national income due to the removal of $(K_1^N - K_1)$ units of capital from Sector 1 to Sector 2 is the area abji less the area fglk. But since $(K_1^N - K_1) = (K_2 - K_2^N)$, the area ecji is exactly matched by the area fglk. Hence, the remaining area of "deadweight loss" is the area abce. But this area can be written:

$$\text{(3-5-1)} \qquad \Delta W = \tfrac{1}{2} T_{K_1} (K_1^N - K_1)$$

$$= -\tfrac{1}{2} T_{K_1} dK_1 .$$

(3-5-1) is merely a special case of the generalized measure of welfare loss presented in Harberger (1964a). Hence, if a set of differential taxes T_{K_i} per unit of capital in Sector i is imposed on a previously neutral tax system, the change in welfare (expressed in units of income) is:

FIGURE 3-5-1:



$$VMP'_{K_i} \equiv VMP_{K_i} - (m_i + \delta_i - \hat{\Theta}_i) q_i$$

$$(3\text{-}5\text{-}2) \qquad \Delta W = -\tfrac{1}{2}\sum_i T_{K_i} dK_i = -\tfrac{1}{2}\sum_{ij}\sum T_{K_i} T_{K_j} . G_{ij}$$

<u>where</u>: $G_{ij} = \partial K_i/\partial T_{K_j}$, in linear form.

This measure of welfare loss is derived in Harberger (1964a). The derivation requires the linearity assumption, $G_{ij} = \partial K_i/\partial T_{K_j}$, and the symmetry of cross-substitution terms, (3-3-44). (3-5-2) is used to measure welfare losses in the sections which follow.

Figure 3-5-1 can be used to relate the measures of tax burden developed in Section 3.4 to the measure of welfare cost developed here. In terms of Figure 3-5-1, the total burden on capital of the imposition of a tax T_{K_1} on capital in Sector 1 is nbco+pfhq. nedo goes to the government, and pfgq (=pfhq+fgh) goes to labour. Hence, the net loss so far is ebc. But labour income in Sector 1 falls by mabn, of which maen goes to the government. Hence, the total loss of national income is abe+ebc=abce. This is the welfare cost derived earlier in this section.

In general, a non-neutral tax disturbance causes national income to fall by ΔW; taxes on capital change by $d\overline{T}_K = \sum_{i=1}^{3} T_{K_i} K_i - T_K^N \sum_{i=1}^{3} K_i^N$; and net income due to capital changes by $dP_K \sum_{i=1}^{3} K_i$. Since there is only one other factor of production, the before-tax income of labour changes by $d(P_L L) = -\Delta W - d\overline{T}_K - dP_K \sum_{i=1}^{3} K_i$.

3.6 SECOND-BEST OPTIMAL TAX POLICY.

The previous Section presented a measure of the welfare cost of non-neutral taxation of capital. The "adding-up" property, (3-3-43), can be used to verify that there is no welfare loss if all the T_{K_i} are the same. Thus, suppose that $T_{K_i} = T_K^N (i=1,2,3)$. Then (3-5-2) is:

$$\Delta W = -\tfrac{1}{2}(T_K^N)^2 \sum_j \sum_i G_{ij} = 0,$$

on using the adding-up property.

Equality of unit tax rates on capital in all sectors generates the "first-best" optimal tax policy. For a number of socio-economic and political reasons this tax policy is unlikely ever to be followed by any Western government. As was seen in Chapter 2, the Governments of Australia, Canada, New Zealand, the United Kingdom, and the United States of America are committed to a policy of subsidizing owner-occupied housing, to encourage home ownership. The following question naturally arises: Given that owner-occupied housing is to be subsidized relative to Sectors 2 and 3, are there values of T_{K_1}, T_{K_2}, and T_{K_3} which would minimize the welfare cost of this subsidy? i.e., what are the second-best optimal tax rates (if they exist) for capital in each sector, given that owner-occupied housing is to be subsidized relative to rented housing? This question is examined in this section.

As is usual in studies of differential tax incidence, it is assumed, here, that the government's fiscal programmes require it to maintain the present total tax yield from capital (denoted $\bar{T}_K$). i.e.,

(3-6-1) $$\sum_{i=1}^{3} T_{K_i} K_i = \bar{T}_K$$

The subsidy to owner-occupied housing is represented by an additional constraint:

(3-6-2) $$T_{K_2} - T_{K_1} = S \quad ; \qquad S > 0.$$

The objective is to find values of T_{K_1}, T_{K_2}, T_{K_3} which minimize the welfare costs of the taxation of capital, subject to the constraints (3-6-1) and (3-6-2).

On using (3-3-49), (3-3-52), (3-6-1) can be written

(3-6-3) $$\sum_{i=1}^{3} T_{K_i} (K_i^N + \sum_{j=1}^{3} G_{ij} T_{K_j}) = \bar{T}_K \ ,$$

where G_{ij} is the linear form of $\partial K_i / \partial T_{K_j}$ (i,j=1,2,3). In (3-6-3), K_i^N, G_{ij}, are constants. The welfare cost of a set of non-neutral taxes T_{K_i} (i=1,2,3) is presented in (3-5-2). Hence, the second-best tax rates are the solution to:

(3-6-4) $$\underset{T_{K_1}, T_{K_2}, T_{K_3}, \lambda_1, \lambda_2}{\text{Minimize}} \quad = -\tfrac{1}{2} \sum_{i=1}^{3} \sum_{j=1}^{3} T_{K_i} T_{K_j} G_{ij}$$

$$-\lambda_1 \{ \sum_{i=1}^{3} T_{K_i} (K_i^N + \sum_{j=1}^{3} T_{K_j} G_{ij}) - \bar{T}_K \}$$

$$-\lambda_2 \{ T_{K_2} - T_{K_1} - S \}$$

$$= -\tfrac{1}{2} \{ G_{11} T_{K_1}^{\ 2} + G_{22} T_{K_2}^{\ 2} + G_{33} T_{K_3}^{\ 2} + 2G_{12} T_{K_1} T_{K_2}$$

$$+ 2G_{13} T_{K_1} T_{K_3} + 2G_{23} T_{K_2} T_{K_3} \}$$

$$-\lambda_1\{T_{K_1}K_1^N+T_{K_2}K_2^N+T_{K_3}K_3^N+G_{11}T_{K_1}{}^2+G_{22}T_{K_2}{}^2$$

$$+G_{33}T_{K_3}{}^2+2G_{12}T_{K_1}T_{K_2}+2G_{13}T_{K_1}T_{K_3}$$

$$+2G_{23}T_{K_2}T_{K_3}-\overline{T}_K\}$$

$$-\lambda_2\{T_{K_2}-T_{K_1}-S\},$$

on using the symmetry conditions (3-3-44). λ_1, λ_2 are the Lagrange multipliers associated with the constraints (3-6-1), (3-6-2) respectively. λ_2 is of especial interest, since it represents the marginal value of the owner-occupier subsidy; i.e., it shows the additional welfare loss resulting from an arbitrarily small increment in the owner-occupier subsidy, evaluated at the second-best optimal solution.

First-order necessary conditions for a minimum include.[28].

(3-6-5) $$\lambda_2 = (2\lambda_1+1)\{G_{11}T_{K_1}+G_{12}T_{K_2}+G_{13}T_{K_3}\}+\lambda_1K_1^N$$

(3-6-6) $$\lambda_2 = -2\lambda_1+1)\{G_{21}T_{K_1}+G_{22}T_{K_2}+G_{23}T_{K_3}\}-\lambda_1K_2^N$$

(3-6-7) $$0 = (2\lambda_1+1)\{G_{31}T_{K_1}+G_{32}T_{K_2}+G_{33}T_{K_3}\}+\lambda_1K_3^N.$$

Combining (3-6-5) and (3-6-6) reveals that

(3-6-8) $$\left(\frac{\lambda_1}{2\lambda_1+1}\right)(K_1^N+K_2^N) = G_{31}T_{K_1}+G_{32}T_{K_2}+G_{33}T_{K_3}$$

But from (3-6-7),

$$(3\text{-}6\text{-}9) \quad \left(\frac{1}{2\lambda_1+1}\right) = \frac{-(G_{31}T_{K_1}+G_{32}T_{K_2}+G_{33}T_{K_3})}{K_3^N}$$

(3-6-9) in (3-6-8) reveals:

$$(3\text{-}6\text{-}10) \quad \left(\sum_{i=1}^{3} K_i/K_3^N\right) \sum_{j=1}^{3} G_{3j}T_{K_j} = 0,$$

which implies

$$(3\text{-}6\text{-}11) \quad \sum_{j=1}^{3} G_{3j}T_{K_j} = 0.$$

(3-6-11) is interesting: It reveals that there is no distortion in the allocation of capital to Sector 3 (other industry) associated with moving from the "first-best" neutral tax system to the second-best non-neutral tax system. i.e., the allocation of capital to Sector 3 under second-best tax policy is the same as under neutrality.

(3-6-11) in (3-6-7) reveals that $\lambda_1 = 0$. Hence, at the second-best optimum, the welfare loss is independent of the absolute level of capital taxation (at least, for small changes). This, too, is a "first-best" result, holding under neutral taxation.

(3-6-2) in (3-6-11) reveals:

$$(3\text{-}6\text{-}12) \quad T_{K_3} = T_{K_1} - \left(\frac{G_{32}}{G_{33}}\right) S ,$$

where the T_{K_1}, T_{K_3} are understood to be the second-best tax rates. The second-best T_{K_1}, T_{K_2} are related by (3-6-2).

(3-6-12) and (3-6-2) reveal that at the second-best optimum,

$$(3\text{-}6\text{-}13) \qquad T_{K_2} \gtreqless T_{K_3} \text{ as } G_{13} = G_{31} \gtreqless 0$$

Hence, when owner-occupied housing is subsidized relative to rented housing it is optimal to tax rented housing and non-residential capital at the same rate only if owner-occupied housing and other industry are economically independent. Complementarity implies $T_{K_2} < T_{K_3}$, for instance.

From (3-6-5), (3-6-6)

$$(3\text{-}6\text{-}14) \quad \lambda_2 = \sum_{j=1}^{3} G_{1j} \cdot T_{K_j} = -\sum_{j=1}^{3} G_{2j} \cdot T_{K_j} .$$

(3-6-14) indicates that an arbitrarily small increment in S (denoted ∂S) induces an additional welfare loss of

$$(3\text{-}6\text{-}15) \quad \Delta W = \lambda_2 \partial S = \sum_{j=1}^{3} \partial S . G_{1j} . T_{K_j} = -\sum_{j=1}^{3} \partial S . G_{2j} . T_{K_j} .$$

The second-best optimal tax rate on owner-occupied housing is obtained by substituting (3-6-2) and (3-6-12) in (3-6-1):

$$(3\text{-}6\text{-}16) \quad T_{K_1} = \frac{\overline{T}_K - SK_2^N + ({}^{G_{32}}/{G_{33}}) SK_3^N - G_{22}S^2 - G_{33}({}^{G_{32}}/{G_{33}})^2 S^2 + 2G_{23}({}^{G_{32}}/{G_{33}}) S^2}{\sum_{i=1}^{3} K_i}$$

(3-6-16) can be used in (3-6-2) and (3-6-12) to obtain second-best tax rates T_{K_2}, T_{K_3}.

Welfare loss under second-best tax policy is, on using (3-6-11) in (3-5-2)

(3-6-17) $$\Delta W = \tfrac{1}{2}\sum_{i=1}^{3} T_{K_i} dK_i$$

$$= \tfrac{1}{2}(T_{K_2} - T_{K_1})dK_1$$

$$= \tfrac{1}{2}SdK_1$$

<u>where</u>: dK_i is the difference between capital employed in Sector i under second-best tax policy, and capital employed in Sector i under neutrality.

The next Chapter, which applies the general equilibrium model developed here, calculates numerical values for the second-best tax rates T_{K_1}, T_{K_2}, T_{K_3}, given that owner-occupied housing is to be subsidised. It also measures the improvement in welfare that would arise if the second-best policy were to replace existing tax policy.

FOOTNOTES TO CHAPTER THREE:

1. Of course, if we are interested in the distortions due to non-neutral taxation, initial taxes are neutral.

2. This procedure is described in detail in Shoven and Whalley (1972). It cannot easily be related to the Harberger approach.

3. The differences correspond to the differences involved in using Paasche and Laspeyres index numbers to measure welfare change.

4. This is analogous to the question of the burden of the corporation tax, analysed in Harberger (1962).

5. These different types of income are described in Section 1.3.

6. The implications of this result are explored in the next section.

7. The "impact" of a tax is to be distinguished from the incidence of the tax. The "impact" relates to the (Seligman (1959, p.203)) "... immediate result of the imposition of a tax on the person who pays it in the first instance."

8. For an account of the controversy, see Krzyzaniak and Musgrave (1963), (1970) on the one side, and Cragg, Harberger, and Mieiszkowski (1967), (1970) on the other.

9. Sumner (1973, p.984).

10. Sumner does not elaborate.

11. Tambini (1969 pp.186-187).

12. ibid. p.187.

13. This seems to be the interpretation Harberger (1964a) has in mind.

14. Depending upon the size of the output effects.

15. It is well-known that this tax policy is not neutral with respect to savings, however.

16. This point is made by Ballentine and Eris (1975, p.636, n.7). It is likely that the assumption of no income losses biases the Harberger model towards a finding of no income losses. But it is not easy to see why, in terms of the equations of the Harberger model.

17. A separable market is one for which there are sufficient behavioural equations to permit the determination of the endogenous variables in that market, independently of other markets.

18. No other intermediate inputs are explicitly recognized in this model.

19. Use of these summary statistics simplifies the complex expressions which follow; it also permits economy in computation in Chapter 4.

20. These reservations about the Ott and Ott (1973) paper were developed in Chapter 1.

21. See Harberger (1964a), for instance. In mathematical language, (3-3-44) is the "integrability condition".

22. Harberger (1964a) offers a different economic explanation. His explanation is less satisfying, since it requires the examination of measures of welfare loss due to taxes. The intuition offered here is not so restrictive.

23. There are no figures available, but Denison (1964, esp. p.18) finds the labour content to be so small that he does not publish it. At the extreme, Ott and Ott (1973) assert that a capital share of unity is definitional.

24. Debreu (1974), Diewert (1977) demonstrate that when the number of consumers equals or exceeds the number of commodities in a pure exchange economy, the aggregate excess demand function need satisfy no restrictions other than continuity and Walras' Law. In particular, the Slutsky conditions will generally not hold. However, Diewert (1980) proves that the Slutsky symmetry conditions hold for aggregate demand functions if individual preferences are "quasi-homothetic" in the Gorman (1953) sense. Essentially this assumption was made to defend the use of aggregate demand curves, earlier in this Section.

25. See Hicks (1946, p.310).

26. Note that $\sum_{i=1}^{3} K_i - M < 0$, so that $-d\overline{T}/(\sum_{i=1}^{3} K_i - M)$ is greater than $-d\overline{T}/\sum_{i=1}^{3} K_i$.

27. Harberger (1966) offers a similar illustration, and others appear in Shoven and Whalley (1972, pp.292-293), and Shoven (1976, pp.1263-1265). This is only an illustration. Many of the tax incidence terms in (3-3-36) do not appear here.

28. On using the symmetry conditions (3-3-44), and the adding-up restrictions (3-3-43).

CHAPTER 4

APPLICATIONS OF THE THREE-SECTOR MODEL

4.1 INTRODUCTION

This Chapter applies the three-sector general equilibrium model of Chapter 3 to an empirical investigation of the distortions created by housing policies in Australia, Canada, New Zealand, the United Kingdom, and the United States. This analysis requires making use of a large number of parameter values. In most cases, parameter values are inferred from independent studies.

Section 3.3 developed the general equilibrium model, and indicated that its application to an analysis of housing policy permits some simplification. The "own-price" tax multipliers, for which numerical values are computed below, are:

$$(4\text{-}1\text{-}1)\quad \frac{\partial K_1}{\partial T_{K_1}} = \frac{K_1\left[B_{21}\{A_1K_2\frac{L_3}{2K_3}+F_{12}\frac{\sigma_3L_3}{P^*_{K_3}}\} - B_{11}\{F_{22}\frac{\sigma_3L_3}{P^*_{K_3}}+A_2K_2\frac{L_3}{2K_3}\}\right]}{D},$$

$$(4\text{-}1\text{-}2)\quad \frac{\partial K_2}{\partial T_{K_2}} = \frac{K_2\left[B_{12}\{A_2K_1\frac{L_3}{1K_3}+F_{21}\frac{\sigma_3L_3}{P^*_{K_3}}\} - B_{22}\{F_{11}\frac{\sigma_3L_3}{P^*_{K_3}}+A_1K_1\frac{L_3}{1K_3}\}\right]}{D},$$

$$(4\text{-}1\text{-}3)\quad \frac{\partial K_3}{\partial T_{K_3}} = \frac{K_1\left[B_{13}\left\{F_{22}\frac{\sigma_3 L_3}{P^*_{K_3}} + A_2 K_{2}\frac{L_3}{K_3}\right\} - B_{23}\left\{A_1 K_{2}\frac{L_3}{K_3} + F_{12}\frac{\sigma_3 L_3}{P^*_{K_3}}\right\} + \frac{\sigma_3 L_3}{P^*_{K_3}}\{A_2 F_{12} - A_1 F_{22}\}\right] + K_2\left[B_{23}\left\{F_{11}\frac{\sigma_3 L_3}{P^*_{K_3}} + A_1 K_{1}\frac{L_3}{K_3}\right\} - B_{13}\left\{A_2 K_{1}\frac{L_3}{K_3} + F_{21}\frac{\sigma_3 L_3}{P^*_{K_3}}\right\} + \frac{\sigma_3 L_3}{P^*_{K_3}}\{A_1 F_{21} - A_2 F_{11}\}\right]}{D}$$

and the change in the net rental price of capital, P_K, is:

$$(4\text{-}1\text{-}4)\quad dP_K = \frac{-\sum_{j=1}^{3} B_{1j}\, dT_{K_j}\left\{F_{22} K_{1}\frac{L_3}{K_3} - F_{21}K_{2}\frac{L_3}{K_3}\right\} - \sum_{j=1}^{3} B_{2j}\, dT_{K_j}\left\{F_{11} K_{2}\frac{L_3}{K_3} - F_{12}K_{1}\frac{L_3}{K_3}\right\} - \frac{\sigma_3 L_3}{P^*_{K_3}} dT_{K_3}\{F_{11}F_{22} - F_{12}F_{21}\}}{D}$$

where: $D = A_1\left\{F_{22} K_{1}\frac{L_3}{K_3} - F_{21}K_{2}\frac{L_3}{K_3}\right\} + A_2\left\{F_{11} K_{2}\frac{L_3}{K_3} - F_{12}K_{1}\frac{L_3}{K_3}\right\}$

$$+\frac{\sigma_3 L_3}{P^*_{K_3}}\{F_{11}F_{22} - F_{12}F_{21}\}$$

From (3-1-2), (3-1-6), note that

$$(4\text{-}1\text{-}5)\quad P^*_{K_i} = q_i\{(1-u_i)r_c(1-\phi_i) + (1-u_m)r_m\phi_i + m_i + \delta_i - \hat{\theta}_i\} + T_{K_i},$$

$i=1,2,3.$

<u>where</u>: $T_{K_i} \equiv \Pi_i + t_i q_i + u_m r_m \phi_i q_i$ is the unit tax rate on capital employed in Sector i. (i=1,2,3)[1]

In applying the model developed in Chapter 3 it is necessary to obtain unit tax rates, T_{K_i}, for capital employed in each sector. In Sector 3, which includes both corporate and unincorporated enterprises, this unit tax is taken to be

$$(4\text{-}1\text{-}6) \quad T_{K_3} = \Pi_3^c K_3^c + \Pi_3^u (K_3 - K_3^c) + t_3 q_3 K_3 + \frac{u_m r_m \{\phi_3^c q_3 K_3^c + \phi_3^u q_3 (K_3 - K_3^c)\}}{K_3}.$$

Each of the other two sectors (owner-occupied and rented housing) are assumed to be composed entirely of unincorporated enterprises,[2] so that

$$(4\text{-}1\text{-}7) \qquad T_{K_i} = \frac{\Pi_i K_i + t_i q_i K_i + u_m r_m \phi_i q_i K_i}{K_i}, \qquad i=1,2,$$

which corresponds to the theoretical unit tax developed in Chapter 3. There is, of course, no error in using the unit tax in (4-1-6) if Sector 3 is composed either entirely of corporate, or of unincorporated, enterprises.

Application of the general equilibrium model requires estimates for every one of the variables in (3-1-3), (3-1-4), (4-1-5). It is, of course, not possible to obtain official estimates for many of these variables, although in many cases it is possible to infer "likely" values from other official statistics. Values chosen for u_i are intended to describe the tax rate of the "representative" asset-owner, and values of u_m, the "representative" mortgagee. It is not possible to avoid error in choosing these values. But perhaps the major source of error in the estimates presented in this Chapter is in the selection of an appropriate set of $\hat{\theta}_i$. These values are intended to represent the "expected" rate of capital gain on assets. The difficulty in selecting "correct" values for these variables needs no emphasis. Since so many of the variables employed in this Chapter are necessarily only approximately accurate, care has been taken to detail the logic by which they were obtained. The Appendix B-4-2 details data sources and methods.

Having declared the likelihood of using "incorrect" values for some of the variables required in the estimations below, it should be noted that this does not prevent the final estimates from providing an "order of magnitude" calculation. Frequently, this is the most that can be expected of exercises in applied economics.

Once the variables in (4-1-5) have been obtained, it is then possible to compute values for

$$(4\text{-}1\text{-}8) \quad M_{K_i} = [P^*_{K_i} - (m_i + \delta_i - \hat{\theta}_i)q_i - T_{K_i}]K_i = (P_{K_i} + \hat{\theta}_i q_i)K_i$$

$$= K_i, \qquad i=1,2,3.$$

$$(4\text{-}1\text{-}9) \quad M = \sum_{i=1}^{3} M_{K_i} + \sum_{i=1}^{3} T_{K_i} K_i + \sum_{i=1}^{3} P_{L_i} L_i$$

$$= \sum_{i=1}^{3} K_i + \sum_{i=1}^{3} T_{K_i} K_i + L_3,$$

$$(4\text{-}1\text{-}10) \qquad \phi_{K_i} = \frac{(P_{K_i} + \hat{\Theta}_i q_i) K_i}{M} = \frac{K_i}{M} ,$$

$$(4\text{-}1\text{-}11) \qquad \phi_K = \sum_{i=1}^{3} \phi_{K_i} = \frac{\sum_{i=1}^{3} K_i}{M} .$$

Values for each of the elasticities η^D_{ij} (i=1,2; j=1,2,3) are obtained on using (3-3-62), (3-3-55), and certain "known" parameter values. This exercise requires estimates of expenditure shares. Expenditure shares are calculated by (from (3-3-53)):

$$(4\text{-}1\text{-}12) \qquad \alpha_i = \frac{P_i D_i}{M} = \frac{P^*_{K_i} K_i}{M} , \qquad i=1,2$$

$$(4\text{-}1\text{-}13) \qquad \alpha_3 = \frac{P_3 D_3}{M} = \frac{(P^*_{K_3} K_3 + L_3) - \sum_{j=1}^{3} (m_j + \delta_j - \hat{\Theta}_j) q_j K_j}{M} .$$

Estimates of expenditure shares also permit estimation of η^M_3 (given η^M_1, η^M_2), according to (3-3-54).

With estimates of the elasticities, it is possible to compute values for

$$(4\text{-}1\text{-}14) \qquad F_{ij} = \eta^M_i \, \phi_{K_j} (T_{K_j} - T_{K_3}) , \qquad i,j=1,2,$$

$$(4\text{-}1\text{-}15) \qquad B_{ij} = \frac{\eta^D_{ij}}{P^*_{K_j}} + \eta^M_i \phi_{K_j} , \qquad i,j=1,2,$$

$$(4\text{-}1\text{-}16) \qquad B_{i3} = \frac{\eta^D_{i3} \Theta_{K_3}}{P^*_{K_3}} + \eta^M_i \, \phi_{K_3} , \qquad i=1,2.$$

$$(4\text{-}1\text{-}17) \qquad A_i = \sum_{j=1}^{3} B_{ij} \qquad i=1,2.$$

Then, on obtaining values for σ_3 (the elasticity of substitution between capital and labour in Sector 3, "other industry"), and $\Theta_{K_3} = P^*_{K_3}K_3/(P^*_{K_3}K_3+L_3)$, estimates of each of the $\partial K_i/\partial T_{K_i}$ (i=1,2,3) are easily obtained. Using estimated values for T_{K_i} (i=1,2,3) the distortions, dK_i, are derived on using (3-3-52), and the welfare loss associated with the non-neutral taxation of housing capital is computed from (3-5-2).

Section 4.2 presents an empirical evaluation of the distortions due to the non-neutral taxation of housing in the five Western countries, identified above. 4.2.1 presents a re-examination of Laidler's analysis. 4.2.2 presents order of magnitude calculations of the size of the owner-occupier subsidy. 4.2.3 estimates the welfare cost of non-neutral taxation of housing. 4.2.4 examines the distribution of the burden of non-neutral taxation among sectors, and between factors. 4.2.5 estimates second-best tax rates (following the analysis of Section 3.6), and estimates improvements in welfare that might be associated with the introduction of the second-best tax policy. Section 4.3 presents some sensitivity analysis. In particular, it indicates the sensitivity of estimates presented in earlier sections to changes in certain key parameter values.

In the case of Australia, Canada, New Zealand, and the United States, the three sectors identified are: Sector 1, owner-occupied housing; Sector 2, rented housing; and Sector 3, other industry. However, in the case of the United Kingdom, the sectors are: Sector 1, owner-occupied housing; Sector 2, local authority housing; and Sector 3, other industry. In the United Kingdom case, private rental housing is ignored: This tenure group accounts for approximately 13 percent of dwellings, only; 56 percent of dwellings are owner-occupied, and the remaining 31 percent are rented from local authorities.

4.2 EMPIRICAL EVALUATION OF THE DISTORTIONS DUE TO THE NON-NEUTRAL TAXATION OF HOUSING IN FIVE WESTERN COUNTRIES.

4.2.1 Re-examination of Laidler's Analysis.

Laidler's (1969) analysis examines the welfare cost (in terms of Marshallian consumer surplus) that arises because of the failure to tax consumers on the (imputed) service income generated by owner-occupied housing in the United States. The analysis is partial equilibrium in nature. The unit subsidy to owner-occupiers is defined as the difference between tax liability if imputed income on owner-occupied housing were treated as "other" income, and present tax liability. The welfare cost is the dead-weight loss associated with this subsidy.

Laidler's partial equilibrium analysis is a special case of the general equilibrium analysis developed here. Because the Laidler model is the most frequently cited analysis of the welfare cost of the owner-occupier subsidy, it is important to examine its general validity in the light of the model developed here.

The value marginal product of owner-occupied housing is the value, in terms of income, of the marginal utility associated with the consumption of owner-occupier housing services. In equilibrium, this marginal utility equals the gross imputed rental value (including taxes) of one unit of owner-occupied housing, $P^*_{K_1}$. In Laidler's analysis, there is no inflation or capital gains. If imputed income on owner-occupied housing were to be taxed like "other income", owner-occupiers would be permitted deductions for repairs, maintenance, and casualty insurance premiums ($m_1 q_1 K_1$), depreciation ($\delta_1 q_1 K_1$), state and local property taxes ($t_1 q_1 K_1$) and mortgage interest payments ($r_m \phi_1 q_1 K_1$), and would be taxed on the net income derived from their equity in the house. Hence, on using (3-1-4), income tax liability under "neutrality"[3.] is (per unit of capital):

(4-2-1) $$\Pi_1(N) = \bar{u}_1 r_c (1-\phi_1) q_1$$ [4.]

The gross rental price of owner-occupied housing under "neutrality" is, on using (4-1-5), (4-2-1), and ignoring capital gains:

(4-2-2) $$P^*_{K_1}(N) = q_1\{r_c(1-\phi_1)+r_m\phi_1+m_1+\delta_1+t_1\}$$

Actual taxation of owner-occupied housing is not neutral in the Laidler sense. The tax treatment of owner-occupied housing has been fully described in Section 2.2 (part (e)). Ignoring capital gains, these tax provisions imply, on using (3-1-4):

(4-2-3) $$\Pi_1 = -\bar{u}_1\{r_m\phi_1+t_1\}q_1.$$

The actual gross rental price is, on using (4-1-5), (4-2-3):

$$(4\text{-}2\text{-}4) \qquad P^*_{K_1} = q_1\{(1-\bar{u}_1)r_c(1-\phi_1)+(1-\bar{u}_1)r_m\phi_1+m_i+\delta_1+(1-\bar{u}_1)t_1\}$$

The subsidy due to the non-neutral taxation of owner-occupied housing is (per unit of capital):

$$(4\text{-}2\text{-}5) \qquad S = P^*_{K_1}(N) - P^*_{K_1} = \Pi_1(N) - \Pi_1$$

$$= \bar{u}_1\{r_c(1-\phi_1)+r_m\phi_1+t_1\}q_1.$$

Since

$$T^N_{K_1} = \Pi_1(N) + t_1q_1 + u_m r_m \phi_1 q_1$$

$$T_{K_1} = \Pi_1 + t_1q_1 + u_m r_m \phi_1 q_1,$$

the unit subsidy can be written:

$$(4\text{-}2\text{-}6) \qquad S = (T^N_{K_1} - T_{K_1}).$$

On assuming (as Laidler does) that $r_c = r_m$, (4-2-5) is

$$(4\text{-}2\text{-}7) \qquad S = \bar{u}_1\{r_c+t_1\}q_1.$$

A comparison of (4-2-7) with (2-2-50), the unit subsidy obtained in Section 2.2, reveals that the unit subsidies are identical if there are no capital gains. The implications of capital gains for the size of the owner-occupier subsidy depend, most significantly, upon λ_1, the proportion of accrued capital gains actually realised in the tax period. Hence, on using (2-2-50), if no capital gains are realised, the unit subsidy is that used by Laidler; but if, on the other hand, all capital gains are realised as they accrue, the unit subsidy is:

$$(4\text{-}2\text{-}8) \qquad S = \bar{u}_1\{r_c+t_1\}q_1 - \frac{\bar{u}_1\hat{\theta}_1 q_1(1-\tfrac{1}{2}\bar{u}_1)}{(1-\bar{u}_1)}$$

where it is assumed that realised capital gains are taxed as long-term capital gains according to the fifty percent rule, described in Section 2.2 (e).

Laidler's computation of the distortion in capital stocks, arising from the owner-occupier subsidy, is a special case of (3-3-48):

$$(4\text{-}2\text{-}9) \qquad dK_1 = \frac{\partial K_1}{\partial T_{K_1}} \cdot dT_{K_1} = \frac{\partial K_1}{\partial T_{K_1}}(T_{K_1} - T^N_{K_1}) = -\frac{\partial K_1}{\partial T_{K_1}} S.$$

Hence, it is implicitly assumed that

$$(4\text{-}2\text{-}10) \qquad \frac{\partial K_1}{\partial T_{K_j}} = 0, \qquad \text{all } j \neq 1.$$

This is the essence of partial equilibrium analysis. A further restriction of the partial equilibrium technique is its implication that the net rate of return on capital is invariant with respect to the tax rate on housing income. This implies that

$$(4\text{-}2\text{-}11) \qquad \frac{\partial P^*_{K_1}}{\partial T_{K_1}} = 1,$$

which is the assumption implicitly made by Ott and Ott (1973).

The tax multiplier, $\partial K_1/\partial T_{K_1}$, may be expanded to yield:

$$(4\text{-}2\text{-}12)\quad \frac{\partial K_1}{\partial T_{K_1}} = \frac{\partial K_1}{\partial P^*_{K_1}} \cdot \frac{\partial P^*_{K_1}}{\partial T_{K_1}} = \eta^D_{K1} \cdot \frac{K^N_1}{P^*_{K_1}(N)}$$

__where__: $\eta^D_{K1} \equiv \frac{\partial K_1}{\partial P^*_{K_1}} \cdot \frac{P^*_{K_1}(N)}{K^N_1}$ is the own-price elasticity of demand for owner-occupied housing, evaluated at the point on the VMP_{K_1} schedule which corresponds to neutral taxation.

As is well-known,[5.] given perfect competition, and profit maximization with constant returns to scale, the own-price elasticity of demand for capital may be expanded so that

$$(4\text{-}2\text{-}13)\quad \eta^D_{K1} = \eta^D_{11}\Theta_{K_1} - \Theta_{L_1}\sigma_1.$$

Since $\Theta_{L_1} = 0$ in this analysis (i.e., $\Theta_{K_1} = 1$), there is no difference between the elasticity of demand for housing as a factor of production (η^D_{K1}), and the elasticity of demand for housing as a consumer good. Accordingly, (4-2-2), (4-2-13) in (4-2-12) gives:

$$(4\text{-}2\text{-}14)\quad \frac{\partial K_1}{\partial T_{K_1}} = \frac{\eta^D_{11}K^N_1}{P^*_{K_1}(N)} = \frac{\eta^D_{11}K^N_1}{q_1\{r_c+m_1+\delta_1+t_1\}},$$

where it has been assumed that $r_c = r_m$.

Since

$$K^N_1 = K_1 - dK_1,$$

(4-2-14) can be written, in terms of K_1:

$$(4\text{-}2\text{-}15)\quad \frac{\partial K_1}{\partial T_{K_1}} = \frac{\eta^D_{11}(K_1-dK_1)}{q_1\{r_c+m_1+\delta_1+t_1\}},$$

which, on using (4-2-9) reveals:

$$(4\text{-}2\text{-}16) \qquad \frac{\partial K_1}{\partial T_{K_1}} = \frac{\eta_{11}^D K_1}{q_1\{r_c+m_1+\delta_1+t_1\}-\eta_{11}^D S},$$

(4-2-16), (4-2-7), in (4-2-9) yields, as the expression for "overinvestment" in housing:

$$(4\text{-}2\text{-}17) \qquad dK_1 = \frac{\eta_{11}^D K_1[\bar{u}_1\{r_c+t_1\}q_1]}{q_1\{r_c+m_1+\delta_1+t_1\}-\eta_{11}^D \bar{u}_1\{r_c+t_1\}q_1}$$

The Marshallian deadweight loss associated with the "overinvestment", dK_1, is:

$$(4\text{-}2\text{-}18) \qquad \Delta W = -\tfrac{1}{2}dT_{K_1}dK_1$$

$$= -\tfrac{1}{2}SdK_1 = -\tfrac{1}{2}\bar{u}_1\{r_c+t_1\}q_1 dK_1.$$

(4-2-17) in (4-2-18) reveals:

$$(4\text{-}2\text{-}19) \qquad \Delta W = \frac{\tfrac{1}{2}\eta_{11}^D K_1[\bar{u}\{r_c+t_1\}q_1]^2}{q_1\{r_c+m_1+\delta_1+t_1\}-\eta_{11}^D \bar{u}_1\{r_c+t_1\}q_1}$$

(4-2-19) is the measure of welfare loss employed by Laidler. Apart from its partial equilibrium restrictions, the obvious weakness of the Laidler analysis is its ignorance of capital gains. If capital gains are included, overinvestment is, on using (2-2-50), (4-2-5), in (4-2-17),

$$(4\text{-}2\text{-}20) \qquad dK_1 = \frac{\eta_{11}^D K_1[\bar{u}_1\{r_c+t_1\}q_1 - \frac{\lambda_1\bar{u}_1\hat{\theta}_1(1-\frac{1}{2}\bar{u}_1)q_1}{(1-\bar{u}_1)}]}{q_1\{r_c+m_1+\delta_1+t_1-\hat{\theta}_1\}-\eta_{11}^D\bar{u}_1\{r_c+t_1\}q_1+\frac{\eta_{11}^D\lambda_1\bar{u}_1\hat{\theta}_1(1-\frac{1}{2}\bar{u}_1)q_1}{(1-\bar{u}_1)}}$$

and the welfare loss is:

$$(4\text{-}2\text{-}21)\quad \Delta W = \frac{\tfrac{1}{2}\eta^{D}_{11}K_1\left[\bar{u}_1\{r_c+t_1\}q_1 - \dfrac{\lambda_1\bar{u}_1\hat{\theta}_1(1-\tfrac{1}{2}\bar{u}_1)q_1}{(1-\bar{u}_1)}\right]^2}{q_1\{r_c+m_1+\delta_1+t_1-\hat{\theta}_1\}-\eta^{D}_{11}\bar{u}_1\{r_c+t_1\}q_1+\dfrac{\eta^{D}_{11}\lambda_1\bar{u}_1\hat{\theta}_1(1-\tfrac{1}{2}\bar{u}_1)q_1}{(1-\bar{u}_1)}}$$

This welfare cost measure might be smaller than, larger than, or equal to, the Laidler measure, depending upon the relative sizes of λ_1, $\hat{\theta}_1$, and $\bar{u}_1$.

Table 4-1-1 re-works the Laidler estimates of dK_1 and ΔW under the following additional assumptions: Capital gains accrue at a nominal rate of 5 percent per annum, but are not realised. The other parameter values used by Laidler are $r_c = .06$, $\delta_1 = .0225$, $m_1 = .0125$, $t_1 = .015$, and $\eta^{D}_{11} = -1.5$. In this special case, (4-2-20) permits

$$(4\text{-}2\text{-}22)\qquad q_1 dK_1 = \frac{0.1125\bar{u}_1 q_1 K_1}{.06+.1125\bar{u}_1},$$

and (4-2-21) permits

$$(4\text{-}2\text{-}23)\qquad \Delta W = \frac{-.00421875\bar{u}_1 q_1 K_1}{.06+.1125\bar{u}_1}$$

Data used in Table 4-1-1 are for the United States, 1960, and are taken from Table 3 of Laidler (1969). The significance of capital gains is clear: A rate of capital gain of 5 percent per annum implies an overinvestment in owner-occupied housing of \$98,331 million (compare with Laidler's \$61,775 million), and an annual welfare loss of \$813 million (compare with Laidler's \$510 million.) The point of this revision is not to suggest that Laidler's estimates are inaccurate; this cannot be asserted without having reliable data on expected rates of capital gain on housing. What the revision is intended to demonstrate is that if there are expectations of capital gains on housing, measures of distortion can generate quite different results, depending upon the treatment of those capital gains.

4.2.2 The Owner-Occupier Subsidy in Five Western Countries

The analysis of Chapter 2 permits an order of magnitude calculation of the size of the owner-occupier subsidy in Australia, Canada, New Zealand, the United Kingdom, and the United States of America, on using the aggregate data of Tables B-1 to B-5. The results, presented in Tables 4-2-2 to 4-2-6, permit a variety of marginal tax rates.

(a) Australia:

From (2-2-8), the aggregate value of the owner-occupier subsidy in Australia is:

$$(4\text{-}2\text{-}24) \qquad SK_1 = \frac{\bar{u}_1}{1-\bar{u}_1}\{(1-\bar{u}_1)r_c(1-\phi_1)+\delta_1-\hat{\theta}_1\}q_1K_1$$

where: $\bar{u}_1$ is the marginal tax rate of the representative owner-occupier.

Using the aggregate data of Table B-1 (Appendix B-4-2), this is

TABLE 4-2-1: Overinvestment in Owner-Occupied Housing and Implied Welfare Losses; Accounting for Capital Gains; United States, 1960.

($ Million)

Value of Owner-Occupied Housing Stock	Relevant Marginal Income Tax Rate	Overinvestment		Annual Welfare Loss	
		Laidler	Revision	Laidler	Revision
7954	0	0	0	0	0
20006	.20	3381	5456	-25	-41
31024	.20	5243	8461	-39	-63
46065	.20	7785	12563	-58	-94
48641	.20	8220	13266	-61	-99
82641	.22	15208	24138	-125	-199
42741	.22	7864	12482	-65	-103
67020	.26	14074	21965	-137	-214
346105		61775	98331	-510	-813

Notes:

1. Data are from Laidler (1969, Table 3).
2. Capital gains are assumed to accrue at a rate of 5% p.a., but not be realised. i.e., $\lambda_1 = 0$; $\hat{\theta}_1 = .05$.
3. Estimates assume $r_{CD} = .06$; $\delta_1 = .0225$; $m_1 = .0125$; $t_1 = .015$; $\eta_{11}^D = -1.5$.
4. Estimates of overinvestment are obtained by applying the formula in (4-2-22) to value-of-owner-occupied-housing data.
5. Estimates of welfare loss are obtained by applying the formula in (4-2-23) to value-of-owner-occupied-housing data.

$$(4\text{-}2\text{-}25) \quad SK_1 = \frac{\bar{u}_1}{1-\bar{u}_1}\{(1-\bar{u}_1)4211.88+1754.95-3218.8\}$$

$$= \bar{u}\,4211.88 - \frac{\bar{u}_1}{1-\bar{u}_1}\,1463.85$$

Table 4-2-2 presents illustrative calculations of the owner-occupier subsidy, for a variety of marginal tax rates effective in Australia in the fiscal year 1976-77. The figures are quite large for reasonable representative marginal tax rates. As Table B-1 reveals, the subsidy to owner-occupied housing is approximately as large as total (direct plus indirect) tax revenue from rented housing.

(b) Canada:

On using (2-2-20), the aggregate value of the owner-occupier subsidy is

$$(4\text{-}2\text{-}26) \quad SK_1 = \frac{\bar{u}_1}{1-\bar{u}_1}\{(1-\bar{u}_1)r_c(1-\phi_1)-(1-\tfrac{1}{2}\lambda_1)\hat{\theta}_1\}q_1K_1$$

Assuming that one-half of capital gains are realised, the data of Table B-2 (Appendix B-4-2) reveal:

$$(4\text{-}2\text{-}27) \quad SK_1 = \bar{u}_1 7585.02- \frac{\bar{u}_1}{1-\bar{u}_1}\,2293.86$$

Table 4-2-3 presents illustrative calculations of the owner-occupier subsidy in Canada, under a variety of marginal tax rates. The marginal tax rates shown are a selection of effective (federal plus provincial) marginal rates applying to individual income-earners

TABLE 4-2-2: The Owner-Occupier Subsidy in Australia; Different Marginal Tax Rates; Fiscal Year Ending 30 June, 1977.[1]

($ million per annum)

	Marginal Tax Rate of Representative Owner-Occupier ($\bar{u}_1$)						
	.20	.27	.35	.45	.55	.60	.65
Subsidy	476.41	595.78	660.91	697.65	527.38	331.35	19.14

Source: See Text.

Notes: 1. Estimates correct to 2 decimal places.

TABLE 4-2-3: The Owner-Occupier Subsidy in Canada; Different Marginal Tax Rates; Year Ending 31 December, 1978.[1]

($ million per annum)

	Marginal Tax Rate of Representative Owner-Occupier $(\bar{u}_1)$[2]				
	.2304	.2736	.36	.5184	.6192
Subsidy	1060.86	1211.27	1440.31	1462.94	966.71

Source: See Text

Notes:
1. Estimates correct to 2 decimal places.
2. Marginal tax rates are a selection of effective (federal plus provincial) rates affecting individual income-earners filing returns in Ontario.

in the province of Ontario. The figures presented in Table 4-2-3 might be compared with a Federal Government expenditure of \$945 million on housing in 1978.[6] Every one of the illustrative calculations presented in Table 4-2-3 exceeds this figure (although in some cases by only a small amount).

(c) New Zealand:

In view of (2-2-26) the subsidy to owner-occupied housing in New Zealand, before the introduction of the mortgage interest rebate is

$$(4\text{-}2\text{-}28) \qquad SK_1 = \frac{\bar{u}_1}{1-\bar{u}_1}\{(1-\bar{u}_1)r_c(1-\phi_1)-\hat{\theta}_1\}q_1K_1.$$

Using the data of Table B-3 (Appendix B-4-2), this is

$$(4\text{-}2\text{-}29) \qquad SK_1 = \frac{\bar{u}_1}{1-\bar{u}_1}\{(1-\bar{u}_1)2010.75-718.13\}$$

$$= \bar{u}_1 2010.75- \frac{\bar{u}_1}{1-\bar{u}_1} 718.13.$$

Table 4-2-4 presents estimates of the subsidy to owner-occupied housing for a variety of different marginal tax rates effective in New Zealand in the fiscal year ending 31 March 1978.

It is clear that the subsidy to owner-occupied housing implied by New Zealand tax legislation is significant. The figures presented in Table 4-6-3 might be compared with other items of Government "expenditure" on housing: In the fiscal year 1977-78, \$54.254 million was

TABLE 4-2-4: The Owner-Occupier Subsidy in New Zealand; Different Marginal Tax Rates; Fiscal Year Ending 31 March, 1978.[1]

($ million per annum)

	Marginal Tax Rate of Representative Owner-Occupier ($\bar{u}_1$)			
	.421459	.485917	.50575	.595
Subsidy	324.30	298.27	282.10	141.37

Source: See Text

Notes: 1. Estimates correct to 2 decimal places.

paid to the Housing Corporation by way of annual appropriation; \$58.3 million was paid out for housing construction under various works programmes. The sum of these two most important actual expenditure items is less than the subsidies computed in Table 4-6-3, even when the marginal tax rate is .595 (the highest marginal tax rate in 1977-78).

(d) <u>The United Kingdom</u>:

In view of (2-2-39) the value of the owner-occupier subsidy in the United Kingdom is

$$(4\text{-}2\text{-}30) \qquad SK_1 = \frac{\bar{u}_1}{1-\bar{u}_1}\{(1-u_1)r_c+\delta_1 - 1-\frac{.3\lambda_1}{\bar{u}_1}\hat{\theta}_1\}q_1K_1$$

Using the data of Table B-4 (Appendix B-4-2), this is

$$(4\text{-}2\text{-}31) \qquad SK_1 = \bar{u}_1 9523.44+\frac{\bar{u}_1}{1-\bar{u}_1}\ 1155.06-\frac{(\bar{u}_1-.15)}{(1-\bar{u}_1)}\ 3390.88$$

Estimates of the annual value of the owner-occupier subsidy in the United Kingdom are presented in Table 4-2-5(a). A variety of marginal tax rates are considered. The figures are large. They might be compared with total explicit subsidies of £1387 million to local authority housing in 1978.[7]

In Section 2.2 the subsidy to local authority housing was defined as the increase in user costs if the target rate of return on local authority housing were set equal to the social rate of opportunity cost, and rentals were taxed as private rentals under present law. In view of

TABLE 4-2-5 (a): The Owner-Occupier Subsidy in the United Kingdom; Different Marginal Tax Rates; Year Ending 31 December, 1978.[1]

(£ million per annum)

	Marginal Tax Rate of Representative Owner-Occupier ($\bar{u}_1$)				
	.25	.30	.40	.50	.60
Subsidy	2313.76	2625.44	3166.55	3543.16	3631.91

Source: See Text.

Notes: 1. Estimates correct to 2 decimal places.

(b): The Subsidy to Local Authority Housing in the United Kingdom; Different Marginal Tax Rates of Representative Landlord; Year Ending 31 December, 1978.[1]

(£ million per annum)

	Marginal Tax Rate of Representative Landlord ($\bar{u}_2$)				
	.25	.30	.40	.50	.60
Subsidy	3646.76	3522.50	3211.85	2776.95	2124.60

Source: See Text.

Notes: 1. Estimates correct to 2 decimal places.

(2-2-40) the annual value of the subsidy to local authority is

$$(4\text{-}2\text{-}32)\quad S(A)K_4=\{(r_c-r_4)(1-\phi_4)+t_4+(\frac{\bar{u}_2}{1-\bar{u}_2})\delta_4-(\frac{\bar{u}_2}{1-\bar{u}_2})(1-\frac{.3\lambda_4}{\bar{u}_2})\hat{\theta}_4\}q_4K_4$$

Using the data of Table B-4, and assuming that $t_4 = .01$, $\lambda_4 = 0.5$, the local authority subsidy is

$$(4\text{-}2\text{-}33)\quad S(A)K_4 = 3107.24+587+\frac{\bar{u}_2}{1-\bar{u}_2}\,890.67-\frac{(\bar{u}_2-.15)}{(1-\bar{u}_2)}\,2582.8$$

Estimates of the value of the local authority subsidy are shown in Table 4-2-5(b). The estimates are much the same as for the owner-occupier subsidy; they dominate the explicit Government subsidy of £1387 million to local authority housing in 1978.

(e) The United States of America:

From (2-2-40), the value of the subsidy to owner-occupied housing in the United States is

$$(4\text{-}2\text{-}34)\quad SK_1 = \bar{u}_1q_1K_1(r_c+t_1)-\lambda_1\bar{u}_1\hat{\theta}_1q_1K_1\frac{(1-\frac{1}{2}\bar{u}_1)}{(1-\bar{u}_1)}$$

Using the aggregate data of Table B-5, this subsidy is

$$(4\text{-}2\text{-}35)\quad SK_1 = \bar{u}_1 12431.85-\bar{u}_1\,\frac{1-\frac{1}{2}\bar{u}_1}{1-\bar{u}_1}\,1240.02,$$

where it has been assumed that one-half of accrued capital gains on owner-occupied housing are realised. Table 4-2-6 presents estimates of the owner-occupier subsidy for a

TABLE 4-2-6: The Owner-Occupier Subsidy in the United States; Different Marginal Tax Rates; Average 1953-59.[1]

($ million per annum)

	Marginal Tax Rate of Representative Owner-Occupier ($\bar{u}_1$)		
	.20	.22	.26
Subsidy	2207.37	2423.73	2853.24

Source: See Text

Notes: 1. Estimates correct to 2 decimal places.

variety of marginal tax rates effective in the United States in 1960.

The subsidies presented in Table 4-2-6 are quite large, as they are in other countries considered here. Even a marginal tax rate of .20 implies a subsidy which is 6.6 percent as large as total tax receipts from capital in all uses, and 50 percent as large as present tax receipts from all housing.

4.2.3 The Welfare Cost of the Non-Neutral Taxation of Housing.

Tables 4-2-7 to 4-2-11 describe the computation of the distortions due to the non-neutral taxation of housing capital, for each of the five Western countries examined in other sections. The tables show unit tax rates, tax multipliers, estimates of overinvestment (dK_i) in each sector, and they present estimates of the annual welfare loss due to non-neutral taxation. Table 4-2-12 presents capital allocations in each country under present law, and under neutral taxation. The estimates presented in Tables 4-2-7 to 4-2-12 are discussed below. Each country is examined.

(a) Australia:

Table 4-2-12 reveals that under neutral taxation 58.65 percent of housing would be owner-occupied. Presently, approximately 68.3 percent is owner-occupied. Non-neutral taxation causes a flow of 785.32 million normal units (generating $785.32 million per annum under

TABLE 4-2-7: Computation of Distortions in Capital Allocation; Australia; Fiscal Year Ending 30 June, 1977.

Sector	Unit Tax on Capital[3] T_{K_i} ($/Normal Unit)		Estimates of $\partial K_i/\partial T_{K_j}$ $\frac{\partial K_i}{\partial T_{K_j}} = \frac{\partial K_j}{\partial T_{K_i}}$ [4]				Estimates of Overinvestment dK_i (Million Normal Units)[1]
1	.0984		-4831.38	1918.98	2912.40		1083.02
2	.2617	x	1918.98	-2085.8	166.82	=	-297.7
3	.3558		2912.40	166.82	-3079.22		-785.32
						Annual Welfare Loss:[2] ($ Million)	122.80

Source: See Text

Notes:

1. One normal unit generates one dollar of net income under present law. Figures correct to 2 decimal places.
2. The welfare loss is a positive figure. It is the negative of the change in national income due to non-neutral taxation.
3. Figures correct to 4 decimal places.
4. Figures correct to 2 decimal places.

TABLE 4-2-8: Computation of Distortions in Capital Allocation; Canada; Year Ending 31 December, 1978.

Sector	Unit Tax on Capital[3] T_{K_i} ($/Normal Unit)		Estimates of $\partial K_i/\partial T_{K_j}$ $\frac{\partial K_i}{\partial T_{K_j}} = \frac{\partial K_j}{\partial T_{K_i}}$ [4]				Estimates of Overinvestment dK_i (Million Normal Units)[1]
1	.1844		-4760.06	2107.48	2652.58		1209.51
2	.2886	x	2107.48	-3288.08	1180.60	=	97.82
3	.5576		2652.58	1180.60	-3833.18		-1307.33
					Annual Welfare Loss:[2] ($ Million)		238.82

Source: See Text.

Notes:

1. One normal unit generates one dollar of net income under present law.
2. The welfare loss is a positive figure. It is the negative of the change in national income due to non-neutral taxation.
3. Figures correct to 4 decimal places.
4. Figures correct to 2 decimal places.

TABLE 4-2-9: Computation of Distortions in Capital Allocation; New Zealand; Fiscal Year Ending 31 March, 1978.

Sector	Unit Tax on Capital T_{K_i} [3] ($/Normal Unit)		Estimates of $\partial K_i/\partial T_{K_j}$ [4] $\frac{\partial K_i}{\partial T_{K_j}} = \frac{\partial K_j}{\partial T_{K_i}}$				Estimates of Overinvestment dK_i (Million Normal Units)[1]
1	.2574		-1534.85	550.97	983.88		222.27
2	.4463	x	550.97	-762.23	211.26	=	-118.61
3	.3776		983.88	211.26	-1195.14		-103.66

$$\begin{bmatrix} .2574 \\ .4463 \\ .3776 \end{bmatrix}' \times \begin{bmatrix} -1534.85 & 550.97 & 983.88 \\ 550.97 & -762.23 & 211.26 \\ 983.88 & 211.26 & -1195.14 \end{bmatrix} = \begin{bmatrix} 222.27 \\ -118.61 \\ -103.66 \end{bmatrix}$$

Annual Welfare Loss:[2] ($ Million): 17.43

Source: See Text.

Notes:

1. One normal unit generates one dollar of net income under present law.
2. The welfare loss is a positive figure. It is the negative of the change in national income due to non-neutral taxation.
3. Figures correct to 4 decimal places.
4. Figures correct to 2 decimal places.

TABLE 4-2-10: Computation of Distortions in Capital Allocation; United Kingdom; Year Ending 31 December, 1978.

Sector	Unit Tax on Capital[3] T_{K_i} (/Normal Unit)		Estimates of $\partial K_i/\partial T_{K_j}$ $\frac{\partial K_i}{\partial T_{K_j}} = \frac{\partial K_j}{\partial T_{K_i}}$ [4]				Estimates of Overinvestment dK_i (Million Normal Units)[1,5]
1	.1016	x	-10149.34	10717.96	568.62	=	-3411.29
4	-.4129		10717.96	-16531.56	5813.60		6705.64
3	.3941		-568.62	5813.60	-5244.98		-3294.35
					Annual Welfare Loss:[2,6] (£ Million)		2917.04

Source: See Text

Notes:

1. One normal unit generates one pound of net income under present law.

2. The welfare loss is a positive figure. It is the negative of the change in national income due to non-neutral taxation.

3. Figures correct to 4 decimal places.

4. Figures correct to 2 decimal places.

5. $dK_i = (G_{i1}T_{K_1} + G_{i4}T_{K_4} + G_{i3}T_{K_3}) - dK_i(1)$, $i=1,4,3$.

6. $$\Delta W = -\tfrac{1}{2}\{T_{K_1}(dK_1+dK_1(1)) + T_{K_4}(dK_4+dK_4(1)) + T_{K_3}(dK_3+dK_3(1))\} - \Delta W(1)$$

TABLE 4-2-11: Computation of Distortions in Capital Allocation; United States; Average 1953-59.

Sector	Unit Tax on Capital[3.] T_{K_i} ($/Normal Unit)		Estimates of K_i / T_{K_j} [4.] $\frac{K_i}{T_{K_j}} = \frac{K_j}{T_{K_i}}$				Estimates of Overinvestment dK_i (Million Normal Units)[1.]
1	.3561		-4076.19	2383.91	1892.28		2622.66
2	.6691	x	2383.91	-2382.00	-1.91	=	-747.66
3	1.4650		1892.28	-1.91	-1690.37		-1875.00
					Annual Welfare Loss:[2.] ($ Million)		1156.58

Source: See Text.

Notes:

1. One normal unit generates one dollar of net income under present law.

2. The welfare loss is a positive figure. It is the negative of the change in national income due to non-neutral taxation.

3. Figures correct to 4 decimal places.

4. Figures correct to 2 decimal places.

TABLE 4-2-12: Capital Allocations in Five Western Countries; Present Law, Neutral Taxation.

Country/ Sector	Capital Allocations					
	Present Law			Neutral Taxation		
	Million Normal Units	% of Total Capital	% of Housing Capital	Million Normal Units	% of Total Capital	% of Housing Capital
Australia:						
1. Owner-Occupied Housing	4405.63		68.30	3322.61		58.65
2. Rented Housing	2044.36		31.70	2342.06		41.35
Total Housing	6449.99	19.02	100	5664.67	16.71	100
3. Other Industry	27464.62	80.98		28249.94	83.29	
TOTALS	33914.61	100		33914.61	100	
Canada:						
1. Owner-Occupied Housing	7585.02		60.30	6375.51		56.56
2. Rented Housing	4993.78		39.70	4895.96		43.44
Total Housing	12578.80	29.19	100	11271.47	26.16	100
3. Other Industry	30509.95	70.81		31817.28	73.84	
TOTALS	43088.75	100		43088.75	100	
New Zealand:						
1. Owner-Occupied Housing	1723.50		70.00	1501.23		63.65
2. Rented Housing	738.64		30.00	857.25		36.35
Total Housing	2462.14	42.36	100	2358.48	40.57	100
3. Other Industry	3350.84	57.64		3454.5	59.43	
TOTALS	5812.98	100		5812.98	100	
United Kingdom:						
1. Owner-Occupied Housing	7587.82		53.09	10999.11		100
4. Local Authority Housing	6705.64		46.91	0.00		0.00
Total Housing	14293.46	28.94	100	10999.11	22.27	100
3. Other Industry	35089.44	71.06		38383.79	77.73	
TOTALS	49382.90	100		49382.90	100	
United States:						
1. Owner-Occupied Housing	17929.84		61.15	15307.18		55.77
2. Rented Housing	11392.81		38.85	12140.47		44.23
Total Housing	29322.65	25.01	100	27447.65	23.41	100
3. Other Industry	87926.69	74.99		89801.69	76.59	
TOTALS	117249.34	100		117249.34	100	

Source: See Text

present law) of capital from non-residential, to residential, uses.

Table 4-2-7 presents the welfare cost of the non-neutral taxation of housing (using 3-5-2). The figure is \$122.8 million per annum. The estimate is large by comparison with Reece's (1975) estimate of \$15.745 million as the annual deadweight loss due to the Australian owner-occupier subsidy in 1966-67.[8.] Whether the figure obtained here is absolutely large or small cannot be answered objectively. Nevertheless, some feel for the magnitude of the loss can be obtained by viewing the measure in a more familiar context. The welfare cost arising from the non-neutral taxation of housing capital was approximately \$9.50 per capita in 1976-77. It might be even more enlightening to view the welfare cost as representing the dollar value of extra resources the government could appropriate if it were to remove the non-neutral tax provisions and seek to maintain the same level of aggregate welfare as at present.[9.] This figure of \$122.8 million might then be compared with a total government outlay[10.] (in 1976-77) of \$164 million for housing and community amenities,[11.] for instance.

The welfare loss measures presented in Tables 4-2-7 to 4-2-11 do not pretend to measure the total loss in welfare due to the non-neutral taxation of capital. One reason is that many deadweight losses are likely to be obscured by the level of aggregation employed here;

distortions within sectors generate no deadweight losses in this analysis. A second, related, reason is that the sectoral break-up used here almost certainly generates smaller measures of welfare loss than would be generated by many other sectoral break-ups, since the welfare loss measure depends upon the nature of the sectoral break-up.

(b) Canada:

Table 4-2-12 reveals that under neutral taxation 56.56 percent of housing would be owner-occupied, compared with 60.3 percent under present law. Nearly all the distortion in capital allocation due to the non-neutral taxation of housing is between owner-occupied housing and non-residential activity: Of the 1307.33 million (normal) units of capital moving from non-residential uses to housing, as a result of non-neutral taxation, 1209.51 million (normal) units (92.52 percent) are attracted to owner-occupied housing.

The estimated welfare cost of the non-neutral taxation of housing is estimated to be $238.82 million in 1978. This is approximately $10 per capita.

(c) New Zealand:

Tables 4-2-9 and 4-2-12 reveal the pattern of distortion in capital allocation, due to non-neutral taxation of housing in New Zealand. Under neutral taxation, 63.65 percent of housing would be owner-occupied; under present law the figure is 70 percent. Non-neutral taxation causes a flow of 103.66 million normal units (generating $103.66

million of net income annually) from non-residential, to residential, uses. Most of the distortion in capital allocation is between housing tenures, however.

The welfare cost of non-neutral taxation is \$17.43 million per annum, approximately \$5.50 per capita in 1977-78. Notwithstanding the considerations elaborated in the Australian study, estimate of welfare loss obtained here does seem to be quite small, relative to the measures derived for other countries. There are some good reasons for this. It is clear from the formula used to measure welfare losses, that the measured loss is larger the more is the tax-induced "underinvestment" concentrated in the most heavily taxed sector, and the larger is the dispersion in unit tax rates among sectors. In the case of New Zealand, more than 50 percent of the overinvestment in owner-occupied housing (the most lightly taxed sector) is at the expense of investment in rented housing (the most heavily taxed sector), but the dispersion in tax rates among sectors is quite low. The tax rate on owner-occupied housing is higher in New Zealand than in the United States because of the general ineligibility of mortgage interest payments and local property taxes as tax deductions in New Zealand. Furthermore, the unit tax on Sector 3 income is remarkably low in New Zealand. In this sector, income taxes as a percentage of gross-of-tax net income, excluding capital gains, (i.e., $\Pi_3 K_3 \div P^*_{K_3} K_3$) are only 9.77 percent. Much of the income of this sector is earned by corporate enterprises, and is nominally subject to corporate taxation at a rate of 45 percent. Any after-tax income distributed to shareholders is then taxed as individual income. The fact that the average tax rate on Sector 3 income is so small is indicative of this sector's ability to take advantage of substantial incentive taxation allowances and exemptions, including two different investment allowance schemes, a tourist promotion allowance, and at least four different export incentive allowances. In 1975-76 (the last year for which this datum is available) these incentive allowances reduced Sector 3 taxable income by some $116.2 million, over 26 percent of income taxes actually paid.

(d) The United Kingdom:

The study of the welfare cost of the non-neutral taxation of housing in the United Kingdom is not as straight-forward as in other countries. Under present United Kingdom housing policy, both owner-occupied and local authority housing receive preferential tax treatment relative to capital employed in non-residential activity. The first step in assessing the welfare implications of this policy is to measure the distortions in capital allocation associated with the policy. As was shown in Chapter 3, the distortions can be measured, in principle, by considering the changes in capital allocation that would eventually occur if the present tax system were replaced by a system which levies the same unit tax rate (possibly zero) on capital in all uses. In the United Kingdom, the empirical results of this study are peculiar.[12] They reveal that the introduction of a neutral tax policy would cause more units of capital to move out of local authority housing than are presently employed in that sector.

The result presented above suggests that neutral taxation would be associated with a negative quantity of capital employed in local authority housing. This is not a feasible result, of course. Because the result is not feasible, it is important to explain why it arises, in the context of the model developed in Chapter 3. One weakness of the general equilibrium model, revealed by this result, is the absence of non-negativity constraints; the model implicitly assumes interior solutions with respect to the efficient allocation of factors. Another weakness of the model, emphasised by this result, is its linearity assumptions; in particular, the assumption of constancy of tax multipliers is untenable for large changes in tax rates.[13] On the other hand, the fact that results like this do not arise in the study of any other country[14] suggests that a large part of the explanation of this result is simply that the United Kingdom housing policy exhibits considerably less neutrality than housing policies in other countries.

Because the "first-best" allocation of capital to local authority housing is not feasible, an empirical assessment of the distortions due to United Kingdom housing policy is necessarily more complicated than for other countries. The analysis proceeds in a number of stages. The first step is to identify the least distorted feasible solution, and the associated policy. The figures presented in Tables 4-2-10 and 4-2-12 are estimates of the differences between capital allocations, and levels of national income, under present law, and under the least distortionary feasible policy. Under the least distortionary feasible policy, there is no capital employed in local authority housing. Under the (infeasible) "first-best" tax policy, the stock of capital employed in local authority housing is -2175.66 million normal units. Hence, with respect to the "first-best" policy, the distortion in the allocation of capital to local authority housing under the least distortionary feasible policy is

(4-2-36) $\quad dK_4(1) = 3501.04$ million normal units.

It can be shown that a tax policy which minimizes welfare loss subject to (4-2-36) is[15].

(4-2-37) $\quad T_{K_1} = T_{K_3} = 0,$

(4-2-38) $\quad T_{K_4} = \dfrac{dK_4(1)}{G_{44}}$

This tax policy implies

(4-2-39) $\quad dK_1(1) = dK_4(1)\left(\dfrac{G_{14}}{G_{44}}\right) = -2269.84$ million normal units.

(4-2-40) $$dK_3(1) = dK_4(1)\left(\frac{G_{34}}{G_{44}}\right) = -1231.20 \text{ million normal units.}$$

(4-2-41) $$\Delta W(1) = \frac{-\frac{1}{2}(dK_4(1))^2}{G_{44}}$$

$$= £\,370.72 \text{ million per annum.}$$

The distortions presented in Tables 4-2-10 and 4-2-12 are

(4-2-42) $$dK_1 = (G_{11}T_{K_1}+G_{14}T_{K_4}+G_{13}T_{K_3})-dK_1(1)$$

$$= -3411.29 \text{ million normal units}$$

(4-2-43) $$dK_3 = (G_{31}T_{K_1}+G_{34}T_{K_4}+G_{33}T_{K_3})-dK_3(1)$$

$$= -3294.35 \text{ million normal units}$$

(4-2-44) $$dK_4 = (G_{41}T_{K_1}+G_{44}T_{K_4}+G_{43}T_{K_3})-dK_4(1)$$

$$= 6705.64 \text{ million normal units}$$ [16]

(4-2-45) $$\Delta W = -\tfrac{1}{2}\{T_{K_1}(dK_1+dK_1(1))+T_{K_4}(dK_4+dK_4(1)) +T_{K_3}(dK_3+dK_3(1))\}-\Delta W(1)$$

$$= £\,2917.04 \text{ million per annum.}$$ [17]

The estimated welfare cost of the present tax system relative to the least distortionary feasible policy is approximately £50 per capita in 1978. This is considerably larger than the figures computed for any other country. But even this might not be the most appropriate manner in which to view the welfare cost of United Kingdom tax policy: It is probably more illuminating to observe that the annual welfare loss is greater than the annual rental value (including subsidies) of local authority housing.

(e) The United States of America:

Table 4-2-12 presents the precentage distribution of capital stocks among sectors under present law, and under neutrality. Under neutral taxation, 55.77 percent of housing would be owner-occupied; during the period 1953-59, the figure was 61.15 percent. Table 4-2-11 reveals that most of the distortion in capital allocation due to the non-neutral taxation of housing is between residential and non-residential uses. This is in contrast to the New Zealand pattern. Non-neutral taxation causes a flow of 1875 million normal units from non-residential, to residential uses (where one normal unit generates $1 of net income in average 1953-59 prices).

The welfare cost of non-neutral taxation averaged $1156.58 million, annually, during the period 1953-59. This estimate can be compared with previous estimates of the welfare cost of the non-neutral taxation of housing in the United States. It is significantly larger than the welfare loss computed by Laidler (1969) on the basis of 1960 data (compare $1156.58 million with $510 million). One interesting reason for this is that, as White and White (1977) have suggested, Laidler's technique underestimates the deadweight loss of the owner-occupier subsidy by failing to consider the distortions created in the allocation of capital among rental and owner-occupation. The model developed here explicitly allows for this particular distortion, and in a more general manner than is adopted by White and White (1977). In addition, the present model permits consideration of distortions between residential and non-residential uses, and these also imply welfare losses.

The estimate of Table 4-2-11 can be updated, and compared with the welfare cost statistic computed by Ott and Ott (1973). Christensen (1971) estimates a stock of capital in corporate and residential uses of \$1480.6 billion, and an after-tax rate of return to capital of 9.5 percent, in 1969. These figures imply an after-tax return to capital in 1969 of \$140,657 million. Following Ott and Ott (1973), the estimate of welfare loss presented in (4-2-127) is found to be (1156.58 $\div$ $(\sum_i r_c q_i K_i)$ = 1156.58 $\div$ (9281.77+5220.99+23715.55) =) 3.873 percent of the after-tax return to capital on average 1953-59 data. Assuming, as Ott and Ott (1973) do, that "economic waste" is a constant proportion of the after-tax income of capital, the welfare cost of the non-neutral taxation of capital in 1969 is estimated to be \$5,447.16 million. This value is significantly smaller than the \$11.7 billion Ott and Ott (1973) obtain using the same data as has been used here. In part, the reason for this difference is the assumption made by Ott and Ott (1973) that capital taxes are not shifted (backwards). A further source of difference is that the present analysis permits complementarity; Ott and Ott (1973) do not.

4.2.4 The Burden of the Non-Neutral Taxation of Housing.

(4-1-4) permits an examination of the distribution of the burden due to non-neutral taxation between factors, and among sectors. A number of non-neutral tax changes are of interest, but only two are considered here. The first (A) is an equal-yield tax disturbance such that

$$d\overline{T}_K = \sum_{i=1}^{3} T_{K_i} K_i - T_K^N(A) \sum_{i=1}^{3} K_i^N = 0.$$

There is only one neutral tax rate satisfying this equation, of course. A second non-neutral tax disturbance of interest (B) is a move from a system which taxes capital in all uses at the rate presently levied on non-residential activity, to the present non-neutral tax system. In this latter case, the change in tax revenue is

$$d\overline{T}_K = \sum_{i=1}^{3} T_{K_i} K_i - T_K^N(B) \sum_{i=1}^{3} K_i^N$$

(where $T_K^N(B) = T_{K_3}$), which is non-zero in general.

Tables 4-2-13 to 4-2-17 present estimates of tax burdens and "benefits" by sector, due to each of the tax disturbances A and B. Estimates are derived for Australia, Canada, New Zealand, the United Kingdom, and the United States.[18.] The tables are largely self-explanatory. A detailed discussion of the Australian results is presented here, and some inter-country comparisons are made.

Table 4-2-13 reveals that capital bears more than the full burden of an equal-yield non-neutral tax disturbance in Australia. The distribution of the burden among sectors is of interest. The "benefit" to Sector 1 (owner-occupied housing) is $1006.78 million per annum. The

TABLE 4-2-13: Tax Benefits and Burdens by Australian Sector; Present Law, Neutral Tax Policies; Fiscal Year Ending 30 June, 1977.

($ Million Per Annum)

Factor		Tax Burden/ Benefit[1.]		Tax Payments Under Neutrality		Difference Between Present & Neutral Taxes[4.]	
		$T_K^N(A)$ [2.]	$T_K^N(B)$ [3.]	$T_K^N(A)$ [2.]	$T_K^N(B)$ [3.]	$T_K^N(A)$ [2.]	$T_K^N(B)$ [3.]
Capital	Sector 1	1006.78	1137.50	1052.13	1182.07	-625.06	-755.78
	2	-337.10	-245.51	741.63	833.22	-206.65	-298.24
	3	-1240.25	-136.27	8945.56	10050.33	831.71	-272.27
	Totals	-570.57	755.72	10739.32	12065.62	0	-1326.29
Labour		447.77	447.77				

Source: See Text

Notes: 1. Defined as the change in net income due to non-neutral taxation. Burdens are negative; benefits are positive.

2. $T_K^N(A)$ = \$0.3167/Normal Unit.

3. $T_K^N(B)$ = \$0.3558/Normal Unit.

4. Defined as: Present Taxes minus Neutral Taxes.

TABLE 4-2-14: Tax Benefits and Burdens by Canadian Sector; Present Law, Neutral Tax Policies; Year Ending 31 December, 1978.

($ Million Per Annum)

Factor		Tax Burden/ Benefit[1]		Tax Payments Under Neutrality		Difference Between Present & Neutral Taxes[4]	
		$T_K^N(A)$ [2]	$T_K^N(B)$ [3]	$T_K^N(A)$ [2]	$T_K^N(B)$ [3]	$T_K^N(A)$ [2]	$T_K^N(B)$ [3]
Capital Sector	1	1299.25	1916.75	2937.27	3554.78	-1538.53	-2156.04
	2	166.73	640.93	2255.63	2729.83	-814.21	-1288.41
	3	-859.46	2222.20	14658.61	17740.27	2352.74	-728.92
Totals		606.52	4779.89	19851.51	24024.88	0	-4173.37
Labour		-845.34	-845.34				

Source: See Text

Notes:

1. Defined as the change in net income due to non-neutral taxation. Burdens are negative; benefits are positive.

2. $T_K^N(A)$ = $0.4607/Normal Unit.

3. $T_K^N(B)$ = $0.5576/Normal Unit.

4. Defined as: Present Taxes minus Neutral Taxes.

TABLE 4-2-15: Tax Benefits and Burdens by New Zealand Sector; Present Law, Neutral Tax Policies; Fiscal Year Ending 31 March, 1978.

($ Million Per Annum)

Factor		Tax Burden/ Benefit[3.]		Tax Payments Under Neutrality		Difference Between Present & Neutral Taxes[4.]	
		$T_K^N(A)$ [2.]	$T_K^N(B)$ [3.]	$T_K^N(A)$ [2.]	$T_K^N(B)$ [3.]	$T_K^N(A)$ [2.]	$T_K^N(B)$ [3.]
Capital Sector	1	244.82	285.17	526.46	566.81	-82.76	-123.11
	2	-105.73	-82.69	300.63	323.67	29.06	6.02
	3	-51.74	41.09	1211.45	1304.28	53.70	-39.14
Totals		87.35	243.57	2038.54	2194.76	0	-156.22
Labour		-104.78	-104.78				

Source: See Text

Notes:

1. Defined as the change in net income due to non-neutral taxation. Burdens are negative; benefits are positive.
2. $T_K^N(A) = \$0.3507$/Normal Unit.
3. $T_K^N(B) = \$0.3776$/Normal Unit.
4. Defined as: Present Taxes minus Neutral Taxes.

TABLE 4-2-16: Tax Benefits and Burdens by United Kingdom Sector; Present Law, Least Distortionary Feasible Policy, Year Ending 31 December, 1978.

(£ Million Per Annum)

Factor			Tax Burden/ Benefit[1]		Tax Payments Under Neutrality		Difference Between Present & Neutral Taxes[4]	
			$T_K^N(A)$[2]	$T_K^N(B)$[3]	$T_K^N(A)$[2]	$T_K^N(B)$[3]	$T_K^N(A)$[2]	$T_K^N(B)$[3]
Capital	Sector	1	-2526.41	-826.67	2635.45	4335.19	-1864.33	-3564.07
		4	6705.64	6705.64	0	0	-2768.84	-2768.84
		3	-206.35	5725.26	9196.99	15128.60	4633.17	-1298.44
Totals			3972.88	11604.23	11832.44	19463.79	0	-7631.35
Labour			-6889.92	-6889.92				

Source: See Text

Notes:

1. Defined as the difference between net income under present law and net income under least distortionary feasible tax policy. Burdens are negative; benefits are positive.

2. $T_K^N(A)$ = £ 0.2396/Normal Unit.

3. $T_K^N(B)$ = £ 0.3941/Normal Unit.

4. Defined as: Present Taxes minus Tax Payments under Least Distortionary Feasible Policy.

TABLE 4-2-17: Tax Benefits and Burdens by United States Sector; Present Law, Neutral Tax Policies; Average Annual, 1953-59.

($ Million Per Annum)

Factor			Tax Burden/ Benefit[1]		Tax Payments Under Neutrality		Difference Between Present & Neutral Taxes[4]	
			T_K^N(A) [2]	T_K^N(B) [3]	T_K^N(A) [2]	T_K^N(B) [3]	T_K^N(A) [2]	T_K^N(B) [3]
Capital	Sector	1	2593.51	4409.07	5220.28	7035.84	-2576.21	-4391.77
		2	-777.54	1084.02	5352.56	7214.12	-2557.99	-4419.55
		3	-2001.52	5879.48	22660.26	30541.27	5134.20	-2746.81
Totals			-185.55	11372.58	33233.10	44791.23	0	-11558.13
Labour			-971.03	-971.03				

Source: See Text

Notes:

1. Defined as the change in net income due to non-neutral taxation. Burdens are negative; benefits are positive.
2. T_K^N(A) = $1.0869/Normal Unit.
3. T_K^N(B) = $1.465/Normal Unit.
4. Defined as: Present Taxes minus Neutral Taxes.

burden on Sector 2 (rented housing) is \$337.10 million per annum. And the burden on Sector 3 (other industry) is \$1240.25 million per annum. The "excess burden" on capital is the net loss in the aggregate net income of capital. This "excess burden" is \$570.57 million per annum. Since the aggregate loss in national income is (this is the welfare loss) \$122.80 million, and there is no change in tax revenue, labour income increases by \$570.57-\$122.80 =) \$447.77 million per annum.

Table 4-2-13 also presents the tax burdens due to the second non-neutral tax disturbance. In this case, the "benefit" to owner-occupied housing dominates the burdens imposed on capital employed in rented housing and in other industry. There is a net "benefit", to capital as a whole, of \$755.73 million per annum. In this case, however, there is a loss of tax revenue of \$1326.29 million per annum. The increase in labour income is (\$1326.29-\$755.75-\$122.80 =) \$447.77 million per annum.

The change in labour income is the same in both cases, A and B. This result can be explained as follows: If taxes on capital are neutral initially, the imposition of a different neutral tax rate causes a redistribution of income between capital and government, with no effect on national income. This is because capital is assumed to be in fixed (perfectly inelastic) supply. There is, in consequence, no burden (or "benefit") on labour resulting from a neutral tax disturbance on capital. Now, in general, a set of tax changes $dT_{K_i}(A) = \{T_{K_i} - T_K^N(A)\}$, i=1,2,3, can be written: $dT_{K_i}(A) = \{T_{K_i} - T_K^N(B)\} - \{T_K^N(A) - T_K^N(B)\}$, $i=1,2,3$. But the set of disturbances $\{T_K^N(A) - T_K^N(B)\}$ has no effect on labour income. Hence, the effect on labour income due to a set of tax disturbances $dT_{K_i}(A) = \{T_{K_i} - T_K^N(A)\}$, $i=1,2,3$, is the same as the effect on labour income due to a different set of tax disturbances $dT_{K_i}(B) = \{T_{K_i} - T_K^N(B)\}$, $i=1,2,3$. This is the result illustrated in Table 4-2-13.

Other countries exhibit somewhat different patterns of tax burden arising from the non-neutral taxation of housing. For instance of the five countries considered, Australia is the only country for which labour "benefits" as a result of the non-neutral tax treatment of housing.

Tables 4-2-13 to 4-2-17 also present estimates of the tax payments by sector under each non-neutral tax policy. It is interesting that in Australia, Canada, and the United States, tax payments on both owner-occupied housing and rented housing, under each neutral tax policy (which imply higher than present unit tax rates), exceed tax payments under present law, even after all the adjustments in capital allocation that would be associated with a move to neutral taxation. In a Marshallian partial equilibrium analysis, of the sort employed by Laidler (1969), this result would be possible only if the demand for housing were relatively inelastic (i.e., $\eta_{ii}^D > -1$, $i=1,2$); in fact, the demand is relatively elastic. Perhaps even more interesting for policy makers is the result that in Sector 3, tax payments actually fall with no change in the tax rate on capital in that sector, under the second of the non-neutral tax disturbances considered here. These observations serve to illustrate the dangers involved in using partial equilibrium models to examine tax incidence.

4.2.5 Second-Best Tax Policy

Section 3.6 developed an analytical discussion of second-best tax policy in relation to housing. This Section presents estimates of the second-best tax rates on capital in each sector, and estimates the improvement in welfare which would result from a move to the second-best tax policy. Tables 4-2-18 and 4-2-19 present the results for each country, excluding the United Kingdom.[19.] Table 4-2-18 shows present, and second-best, tax rates on capital, and the welfare improvement associated with the second-best policy, in each country. Table 4-2-19 shows capital allocations under second-best tax policy.

The results presented in Tables 4-2-18 and 4-2-19 are remarkable. In particular, the United States' results deserve some discussion. The results presented in Table 4-2-18 reveal that the United States Government could initiate a policy which taxed capital in all uses at lower rates than at present, while still maintaining the same total tax yield from capital, and the same unit subsidy to owner-occupied housing, and in so doing could remove 89 percent of the welfare cost of non-neutral taxation under present law. Table 4-2-18 presents the appropriate set of unit tax rates to achieve these results. The second-best

TABLE 4-2-18: Second-Best Tax Policy; Comparison of Present and Second-Best Tax Rates; Welfare Improvement due to Second-Best Tax Policy; Four Western Countries.[3]

Country	Tax Rates on Capital			Welfare Improvement	
	T_{K_1}	T_{K_2}	T_{K_3}	Units of National Income[1]	%[2]
Australia	($/Normal Unit)			($m.p.a.)	
Present Law	.0984	.2617	.3558		
Second-Best	.2996	.4629	.3084	95.12	77.46
Canada	($/Normal Unit)			($m.p.a.)	
Present Law	.1844	.2886	.5576		
Second-Best	.4529	.5301	.4580	222.94	93.35
New Zealand	($/Normal Unit)			($m.p.a.)	
Present Law	.2574	.4463	.3776		
Second-Best	.3074	.4963	.3408	4.5	25.82
United States	($/Normal Unit)			($m.p.a.)	
Present Law	.3561	.6691	1.4650		
Second-Best	.2531	.5661	.2527	1032.01	89.23

Source: See Text

Notes:

1. The figure is: Present Welfare Loss-Second-Best Welfare Loss.

2. The figure is:

$$\frac{-(\text{Second-Best Welfare Loss}-\text{Present Welfare Loss})}{\text{Present Welfare Loss}}$$

3. United Kingdom not analysed.

TABLE 4-2-19: Capital Allocations in Four Western Countries; Present Law, Second-Best Tax Policy.[1]

Country/ Sector	Capital Allocations					
	Present Law			Second-Best Taxation		
	Million Normal Units	% of Total Capital	% of Housing Capital	Million Normal Units	% of Total Capital	% of Housing Capital
Australia:						
1. Owner-Occupied Housing	4405.63		68.30	3661.61		64.64
2. Rented Housing	2044.36		31.70	2003.06		35.36
Total Housing	6449.99	19.02	100	5664.67	16.71	100
3. Other Industry	27464.62	80.98		28249.94	83.29	
TOTALS	33914.61	100		33914.61	100	
Canada:						
1. Owner-Occupied Housing	7585.02		60.30	6680.26		59.27
2. Rented Housing	4993.78		39.70	4591.21		40.73
Total Housing	12578.80	29.19	100	11271.47	26.16	100
3. Other Industry	30509.95	70.81		31817.28	73.84	
TOTALS	43088.75	100		43088.75	100	
New Zealand:						
1. Owner-Occupied Housing	1723.50		70.00	1638.17		69.46
2. Rented Housing	738.64		30.00	720.31		30.54
Total Housing	2462.14	42.36	100	2358.48	40.57	100
3. Other Industry	3350.84	57.64		3454.5	59.43	
TOTALS	5812.98	100		5812.98	100	
United States:						
1. Owner-Occupied Housing	17929.84		61.15	16103.18		58.67
2. Rented Housing	11392.81		38.85	11344.47		41.33
Total Housing	29322.65	25.01	100	27447.65	23.41	100
3. Other Industry	87926.69	74.99		89801.69	76.59	
TOTALS	117249.34	100		117249.34	100	

Source: See Text

Notes: 1. United Kingdom not analysed.

tax rates derived for Canada remove an even larger percentage of the welfare cost of non-neutral taxation, but requires taxing housing (both owner-occupied, and rented) more heavily than at present.

The United States' result has some analogy with the "Laffer curve", at the centre of the recent renewed interest in so-called "supply-side" economics. Supply-side economics emphasises the role of tax rate changes in distorting economic decisions between work and leisure, savings and consumption, and market and non-market activity. The Laffer curve suggests the possibility that increases in tax rates might distort economic decisions in such a way as to reduce aggregate output, and even tax revenue. The United States' result obtained above arises because of the effects of tax rate changes on the allocation of capital, rather than on the total supply of capital. Further, the result depends upon unequal changes in sectoral tax rates: an equal reduction in tax rates in each sector has no aggregate supply-side effects in the model developed in Chapter 3.[20]

Of all the countries examined here, New Zealand exhibits the smallest welfare improvement under a second-best tax policy. In part, the reason for this is the relatively low degree of dispersion among tax rates under present law. But even in the case of New Zealand, the second-best tax policy would remove more than 25 percent of the welfare loss associated with present tax policy. Significantly, in the case of New Zealand, capital allocations under second-best tax policy are not very different from capital allocations under present law. Hence the "social costs" (referred to in Chapter 1) associated with a shift from owner-occupied to rental housing are likely to be insignificant.

4.3 SENSITIVITY ANALYSIS.

Applications of the three-sector general equilibrium model of tax incidence require the specification of a large number of parameter values. In particular, own-price, cross-price, and income elasticities of demand are required for each of the three sectoral outputs, and an estimate of the elasticity of substitution between capital and labour in Sector 3 ("Other Industry") has also to be specified. η_{33}^{D}, the own-price elasticity of demand for Sector 3 final output, presents the most difficulties. The reason is that Sector 3 is a "catch-all", residual, sector. Even on theoretical grounds, it is not clear exactly what η_{33}^{D} represents, and empirical attempts to measure such an elasticity would be nonsensical.

It turns out that some of the distortions estimated in earlier sections are quite sensitive to changes in certain parameter values; in particular, to changes in η_{33}^{D}. This is not surprising, for two principal reasons: First, the model is linear, so that even very small changes in slope parameters at one set of equilibrium points can generate large shifts between equilibria. Second, the model developed here is characterised by a very high degree of interdependence among sectors, and among variables within sectors. This interdependence is at two degrees. One degree of interdependence is due to the empirical assumption that demand equations satisfy the restrictions of the Slutsky equations. Hence, changing one elasticity can, in principle, change all other elasticities. The other, more important, degree of interdependence arises because of the structure of the tax incidence model developed in Chapter 3. The interest in general equilibrium models arises from the desire to explore the interdependence of one variable with respect to others. But the model developed in Chapter 3 imposes a further degree of interdependence through its assumption of fixed factor supplies. In particular, the "adding-up" property (3-3-43) is restrictive in this sense.

An examination of the sensitivity of endogenous variables to parameter changes in the tax incidence model developed here is complicated by the possibility of complementarity among sectors. Hence, if demand equations are required to satisfy the Slutsky conditions, and if the own-price and income elasticities of demand for Sectors 1 and 2 exceed unity (as they do here) values of η_{33}^{D} much less than unity (in absolute value) imply gross complementarity between Sectors 1 and 3, and 2 and 3. If η_{33}^{D} is sufficiently small (so that cross-price effects dominate own-price effects in Sector 3), the tax multipliers $\partial K_1/\partial T_{K_3} = \partial K_3/\partial T_{K_1}$, and $\partial K_2/\partial T_{K_3} = \partial K_3/\partial T_{K_2}$ are all negative. The "adding-up" property then implies that $\partial K_3/\partial T_{K_3}$ is positive. This incredible result is not inconceivable on theoretical grounds, although it has some unfortunate implications for

TABLE 4-3-1: Sensitivity Analysis of Welfare Cost Estimates; Australia; Welfare Cost of Non-Neutral Taxation ($ Million per annum)

Own-Price Elasticities		Sector 3 Elasticity of Substitution (σ_3)			
		$\sigma_3 = 0.5$		$\sigma_3 = 1.0$	
$\eta^D_{11} = \eta^D_{22}$	η^D_{33}	$\eta^M_1 = \eta^M_2 = 1.2$	$\eta^M_1 = \eta^M_2 = 1.5$	$\eta^M_1 = \eta^M_2 = 1.2$	$\eta^M_1 = \eta^M_2 = 1.5$
-1.2	-1.00	140.42	146.90	154.38	165.17
	-0.95	116.77	126.17	122.80	135.69
	-0.90	(*)	99.15	(*)	102.00
	-0.85	(*)	(*)	(*)	(*)
	-0.80	(*)	(*)	(*)	(*)
	-0.75	(*)	(*)	(*)	(*)
	-0.70	(*)	(*)	(*)	(*)
	-0.65	(*)	(*)	(*)	(*)
	-0.60	(*)	(*)	(*)	(*)
	-0.55	(*)	(*)	(*)	(*)
	-0.50	(*)	(*)	(*)	(*)
-1.8	-1.00	182.52	187.95	199.80	209.79
	-0.95	181.16	169.27	169.66	181.66
	-0.90	(*)	144.77	(*)	149.47
	-0.85	(*)	(*)	(*)	(*)
	-0.80	(*)	(*)	(*)	(*)
	-0.75	(*)	(*)	(*)	(*)
	-0.70	(*)	(*)	(*)	(*)
	-0.65	(*)	(*)	(*)	(*)
	-0.60	(*)	(*)	(*)	(*)
	-0.55	(*)	(*)	(*)	(*)
	-0.50	(*)	(*)	(*)	(*)

Source: See Text

Notes: (*) denotes that the parameters imply $\partial K_i/\partial T_{K_i} < 0$, for some i = 1,2,3.

TABLE 4-3-2: Sensitivity Analysis of Welfare Cost Estimates; New Zealand; Welfare Cost of Non-Neutral Taxation ($ Million per annum).

Own-Price Elasticities		Sector 3 Elasticity of Substitution (σ_3)			
		$\sigma_3 = 0.5$		$\sigma_3 = 1.0$	
$\eta^D_{11} = \eta^D_{22}$	η^D_{33}	$\eta^M_1 = \eta^M_2 =$ 1.2	$\eta^M_1 = \eta^M_2 =$ 1.5	$\eta^M_1 = \eta^M_2 =$ 1.2	$\eta^M_1 = \eta^M_2 =$ 1.5
-1.20	-1.00	13.12	10.02	14.31	11.07
	-0.95	16.11	13.06	17.43	14.20
	-0.90	19.02	16.05	20.55	17.32
	-0.85	21.79	18.98	23.66	20.44
	-0.80	(*)	21.77	(*)	23.55
	-0.75	(*)	(*)	(*)	(*)
	-0.70	(*)	(*)	(*)	(*)
	-0.65	41.79	(*)	(*)	(*)
	-0.60	41.70	40.03	(*)	(*)
	-0.55	43.90	40.95	44.67	(*)
	-0.50	46.58	43.36	46.48	43.39
-1.80	-1.00	24.47	21.66	26.63	23.51
	-0.95	27.11	24.44	29.63	26.55
	-0.90	29.52	27.10	32.60	29.56
	-0.85	31.49	29.52	35.50	32.54
	-0.80	(*)	31.51	(*)	35.46
	-0.75	(*)	(*)	(*)	(*)
	-0.70	(*)	(*)	(*)	(*)
	-0.65	74.87	(*)	(*)	(*)
	-0.60	62.47	68.32	(*)	(*)
	-0.55	61.77	60.62	82.51	(*)
	-0.50	63.16	60.67	65.68	72.05

Source: See Text

Notes: (*) denotes that the parameters imply $\partial K_i/\partial T_{K_i} < 0$, for some $i = 1,2,3$.

Marshallian equilibrium analysis. The result is, however, at variance with every other general equilibrium analysis of tax incidence. Hence, values of η_{33}^{D} which produce this result are unsuitable.

The parameters for which sensitivity analysis has been conducted are η_{11}^{D}, η_{22}^{D}, η_{1}^{M}, η_{2}^{M}, σ_3, and η_{33}^{D}. Tables 4-3-1 and 4-3-2 present the results of some of the analysis. The tables present estimates of the welfare cost of the non-neutral taxation of housing in Australia and New Zealand, respectively. Other countries exhibit similar degrees (though not necessarily similar patterns) of sensitivity. The sensitivity analysis was primarily concerned with an examination of the significance of the η_{33}^{D} value. Values of $\eta_{33}^{D} = -1.00+(n-1)x$, $x = .05$, $n = 1,2,\ldots,11$, were tested. Welfare cost estimates are shown only for cases in which $\partial K_i/\partial T_{K_i} \geq 0$, $i=1,2,3$. Other cases are denoted by (*).

Of the two sets of results reported in Tables 4-3-1 and 4-3-2, the New Zealand case is the more interesting. Changes in the income elasticity of demand for housing do not appear to significantly affect the estimated welfare cost. The same is true of changes in the elasticity of substitution between capital and labour. However, changes in the own-price elasticities of demand for final outputs imply quite large changes in estimates of welfare cost. The estimates are particularly sensitive to the size of $\eta_{11}^{D} = \eta_{22}^{D}$. Ceteris paribus, a larger (in absolute value) own-price elasticity of demand for housing implies a large estimate of the welfare cost of the non-neutral taxation of housing. This result, which is true for all the countries considered in this Chapter, is not surprising. The larger is $\eta_{11}^{D} = \eta_{22}^{D}$ (in absolute value), the larger are the distortions due to a non-neutral tax policy which favours owner-occupied housing over capital employed in other sectors.

Footnotes to Chapter 4.

1. Π_i is obtained from (3-1-3), (3-1-4), depending upon whether the unit of capital is employed in corporate, or unincorporated, economic activity. In applying the three-sector model developed in Chapter 3, corporate and unincorporated enterprises are combined, in Sector 3. This procedure essentially ignores an interesting aggregation problem. The problem arises because of the assumption, made in the development of the general equilibrium model, that all of the output of a particular sector is produced with a particular production function. Since there are constant returns to scale, this assumption does not restrict the number of separate firms that might be combined in any sector, provided each firm faces the same factor costs and output prices. But when some firms are corporate, and others unincorporated, different firms do face different factor costs, even though they are producing an identical output, and selling that output at an identical price. In particular, a comparison of (2-2-1) with (3-1-1) reveals that the user cost of capital will usually differ between corporate and unincorporated enterprises. Corporate enterprises will typically face higher capital to labour price ratios than unincorporated enterprises. If all enterprises employ the same linear homogeneous production function, corporate enterprises will employ smaller amounts of capital per worker, and will have higher average costs.

2. The United States' case provides an exception.

3. This is the sense Laidler attaches to the term.

4. Again, the marginal tax rate is relevant here.

5. Allen (1972, pp.372-374), for instance.

6. International Monetary Fund, Government Finance Statistics Yearbook, Vol. V., 1981, p.126.

7. United Kingdom, National Income and Expenditure, 1979, Table 8.3.

8. Reece (1975, at p.227).

9. Laidler (1969) offers a similar interpretation of the deadweight loss associated with the owner-occupier subsidy in the United States of America.

10. i.e., including local, state, and federal.

11. <u>Australian National Accounts, National Income and Expenditure, 1977-78</u>, p.34.

12. These results have not been presented here.

13. Hence, the result illustrates an important advantage of the Shoven and Whalley (1972) model of tax incidence, which avoids this linearity assumption.

14. The distortions estimated for other countries appear insignificant against the United Kingdom results.

15. There is more than one set of taxes which will generate this result: Any unit tax rate added to the tax rates presented in (4-2-37) and (4-2-38) will generate no additional distortions.

16. This is the stock of capital employed in local authority housing under present law.

17. This is clearly not the same as $(T_{K_1} dK_1 + T_{K_4} dK_4 + T_{K_3} dK_3)$.

18. The United Kingdom results show the tax benefits and burdens which arise because of a policy which replaces the least distortionary feasible tax system with present law.

19. For the United Kingdom, an analogous second-best analysis might be to discover those tax rates which minimize welfare cost subject to both owner-occupied, and local authority, housing being subsidized relative to capital employed in other industry. That analysis has not been pursued here.

20. This is because of the assumption of a fixed total stock of capital, of course.

APPENDIX B-4-2: DATA SOURCES AND METHODS:

This appendix details the derivation of raw data and certain parameter values, required in an application of the three-sector general equilibrium model. Data sources and methods are presented for each of the five Western countries analysed in Section 4.2.

Australia

Data are drawn primarily from the Australian Bureau of Statistics publication, Australian National Accounts, National Income and Expenditure, 1977-78, and are for the fiscal year ending 30 June, 1977. Sector 3 comprises private non-farm activity, including: Mining; manufacturing, electricity, gas and water; community services; entertainment and personal services; construction; wholesale and retail trade; transport, storage and communication; finance and business services. Public enterprise, public administration, defence, agriculture, forestry, fishing, and hunting, are ignored.

Gross operating surplus of Sector 3 corporate and unincorporated enterprises is \$16570 million. Gross operating surplus is defined as: "The operating surplus, before deduction of depreciation provisions, dividends, interest, royalties and land rent, and direct taxes payable...."[1] It provides an estimate of:

(B-1) $P^*_{K_3}K_3-(m_3q_3K_3+t_3q_3K_3)=(1-u_3)r_c(1-\phi_3)q_3K_3$

$+r_m\phi_3q_3K_3-\hat{\theta}_3q_3K_3+\delta_3q_3K_3+\Pi_3K_3=\$16570$ million.

Actual gross rents on rented housing are:

(B-2) $P^*_{K_2}K_2 = \$2348$ million.

Imputed gross rents on owner-occupied housing are $5061 million. This figure is obtained by applying average actual rents on tenanted dwellings to numbers of owner-occupied housing stock. It is an estimate of

(B-3) $P^*_{K_2}K_1 = \$5061$ million.

Comparing (B-3), (B-2) reveals that

(B-4) $K_1 = 2.155\,K_2$

Total rates and insurance on residential property are $1231 million. Maintenance expenses are $1030 million. Following Reece (1975, pp.223-224), it is supposed that

$$m_1 = m_2 = \frac{5}{3}t_1 = \frac{5}{3}t_2.$$

This implies that

(B-5) $m_1q_1K_1 = \$965.22$ million

(B-6) $m_2q_2K_2 = \$447.9$ million

(B-7) $t_1q_1K_1 = \$579.14$ million

(B-8) $t_2q_2K_2 = \$268.74$ million

Total depreciation allowances for residential property, reported in the National Accounts, are $549 million. This estimate seems remarkably small, relative to the estimates of maintenance expenses. Both Reece (1975), and Laidler (1969) use values which imply

(B-9) $$m_1 = m_2 = .55\delta_1 = .55\delta_2$$

These values produce:

(B-10) $$\delta_1 q_1 K_1 = \$1754.95 \text{ million.}$$

(B-11) $$\delta_2 q_2 K_2 = \$814.36 \text{ million.}$$

(B-2) can be expanded to obtain:

(B-12) $$(1-u_2)r_c(1-\phi_2)q_2K_2+r_m\phi_2q_2K_2+m_2q_2K_2+\delta_2q_2K_2$$
$$+t_2q_2K_2-\hat{\Theta}_2q_2K_2+\Pi_2K_2=\$2348 \text{ million.}$$

Corporate activity in housing is negligible. According to Australian tax law, income tax liability on rented housing is, on using (3-1-4),

(B-13) $$\Pi_2K_2 = u_2(1-\phi_2)r_cq_2K_2+\left(\frac{u_2}{1-u_2}\right)\delta_2q_2K_2-\left(\frac{u_2}{1-u_2}\right)\hat{\Theta}_2q_2K_2.$$

(B-13), (B-6), (B-8), (B-11) in (B-12) reveal:

(B-14) $$r_cq_2K_2 = 1631.36 + \frac{\hat{\Theta}_2q_2K_2}{1-u_2} - \frac{814.36}{1-u_2},$$

on using the capital market equilibrium conditions that $r_c = r_m$.

Direct income taxes paid on total household income, including income from unincorporated enterprises and ownership of dwellings amounted to \$11047 million in 1976-77. This is 16.32 percent of total household income, excluding imputed income of owner-occupied housing (\$3315.71 million). Hence, it has been supposed that

(B-15) $$u_1 = u_2 = u_3 = u_m = .1632$$

(B-15) in (B-14) reveals:

(B-16) $$r_c q_2 K_2 = 658.176 + 1.195\hat{\theta}_2 q_2 K_2$$

There are no data on expected capital gains. However, rates of interest in 1976-77 were approximately three to four times the depreciation rate on housing of 0.225, used by Reece (1975) and Laidler (1969). If $r_c = 3\delta_1$, then:

(B-17) $$r_c q_2 K_2 = \$2443.08 \text{ million.}$$

(B-18) $$\hat{\theta}_2 q_2 K_2 = \$1493.64 \text{ million.}$$

(B-19) $$r_c q_1 K_1 = \$5264.85 \text{ million.}$$

(B-20) $$\hat{\theta}_1 q_1 K_1 = \$3218.80 \text{ million.}$$

Depreciation allowances on all non-farm, non-residential business were \$4308 million in 1976-77. Public enterprise depreciation amounted to \$866 million. Since public enterprise involvement in agriculture, forestry, fishing and hunting is negligible, and is not very significant in housing,[2.] all of the \$866 million is subtracted from \$4308 million to obtain depreciation allowances for Sector 3. Hence,

(B-21) $$\delta_3 q_3 K_3 = \$3442 \text{ million}$$

Supposing that $m_3 = .55\delta_3$,

(B-22) $$m_3 q_3 K_3 = \$1893.1 \text{ million.}$$

Income taxes on Sector 3 are calculated in the following manner: Total direct income taxes on companies amounted to \$2803 million. It is supposed that all of this is due to Sector 3. Then, total income taxes on corporate capital in Sector 3 are:

(B-23) $$\Pi_3^c K_3^c = 2803 + u_3(1-\phi_3^c)q_3K_3^c$$

Income taxes on unincorporated capital in Sector 3 are;

(B-24) $$\Pi_3^u K_3^u = u_3(1-\phi_3^u)q_3K_3^u - (\frac{u_3}{1-u_3})\hat{\Theta}_3 q_3 K_3^u.$$

Combining (B-23), (B-24) reveals, if $\phi_3^c = \phi_3^u$,

(B-25) $$\Pi_3 K_3 = 2803 + u_3(1-\phi_3)q_3K_3 - (\frac{u_3}{1-u_3})\hat{\Theta}_3 q_3 K_3^u$$

It is supposed that one-half of Sector 3 capital gains accrue to corporate enterprises, and one-half to individuals.[3] Then,

(B-26) $$\Pi_3 K_3 = 2803 + u_3(1-\phi_3)r_c q_3 K_3 - (\frac{u_3}{1-u_3})X\cdot 5\hat{\Theta}_3 q_3 K_3.$$

Additional data are obtained from taxation statistics: Total direct income taxes amounted to (2803 + 11047=) \$13850 million. Income derived from the agriculture, forestry, fishing and hunting industry amounted to (corporate income and income of public enterprises excluded) \$3973 million. Applying the individual average tax rate reveals income taxes in this industry of \$648.39 million. The rest of total income taxes must be allocated among labour and capital in each of the three sectors. Income taxes on labour in Sector 3 (it is assumed that no labour is employed in Sectors 1 and 2) are estimated by multiplying total wages, salaries, and supplements[4] in Sector 3 industry by .1632, the average individual tax rate. The figure obtained is \$6920.33 million. Hence:

$$\text{(B-33)} \quad \Pi_1K_1+\Pi_2K_2+\Pi_3K_3+u_m\{r_m\phi_1q_1K_1+r_m\phi_2q_2K_2 +r_m\phi_3q_3K_3\}= 13850 - 648.39 - 6920.23$$

According to Australian tax law effective in the fiscal year 1976-77, there is a tax rebate of 40 percent of property tax payments. The rebate is granted only when the total of rates and other concessional deductions exceed \$1350, and only for the first \$300 of rate payments. Beginning July 1975, owner-occupiers were permitted to deduct a proportion β_1 of mortgage interest payments. β_1 was equal to one for gross family incomes under \$4000. From July 1976 this deduction was confined to first-home buyers only, and only during the first five years of home-ownership.[5.] An estimate of Π_1K_1 requires an estimate of the incidence of the mortgage interest deduction, and the property tax rebate, on the representative owner-occupier, in the fiscal year 1976-77. Here it has been supposed that (the notation is from earlier Sections)

$$\beta_1 = .5, \qquad R_1 = .4\, t_1q_1K_1$$ [6.]

These assumptions imply total income taxes on owner-occupied housing of (on using (3-1-4)):

$$\text{(B-34)} \qquad \Pi_1K_1 = -.5u_1r_m\phi_1q_1K_1-.4t_1q_1K_1$$

(B-13), (B-26), (B-34), in (B-33) reveals:

(B-35) $.5r_m\phi_1 q_1 K_1 + .1632 r_c q_3 K_3 - .0975\hat{\theta}_3 q_3 K_3 = 3443.80$

It is assumed that $\phi_1 = 0.2$. This is the figure obtained by the 1962-63 Survey of Consumer Finances (Sydney), reported in Reece (1975, at p.225). It is consistent with the United States figure. Then, (B-19) in (B-35) reveals:

(B-36) $.1632 r_c q_3 K_3 - .0975\hat{\theta}_3 q_3 K_3 = \$3357.882$ million.

Further, from (B-1),

(B-37) $r_c q_3 K_3 - 1.0975\hat{\theta}_3 q_3 K_3 = \$10325$ million

Combining (B-36), (B-37), reveals:

(B-38) $\hat{\theta}_3 q_3 K_3 = \$20497.5$ million

(B-39) $r_c q_3 K_3 = \$32821.02$ million.

Finally, it is assumed that

(B-40) $\phi_2 = .5;\ \phi_3 = .2;$[7.] $t_3 = t_1 = t_2$.

Estimates of each of the user cost components, for each of Sectors 1 to 3, are easily derived from the details presented above. These data are presented in Table B-1.

Total wages, salaries, supplements in Sector 3 industry amount to \$42403.98 million. Hence,

(B-41) $L_3 = 42403.98$

TABLE B-1: User Cost Components; Australia; Fiscal Year Ending 30 June, 1977.

($ million)

Sector	$(1-u_i)r_c(1-\phi_i)q_iK_i$	$(1-u_m)r_m\phi_iq_iK_i$	$(m_i+\delta_i)q_iK_i$	$\hat{\theta}_iq_iK_i$	$T_{K_i}K_i$ [1.]	$C_iK_i=P^*_{K_i}K_i$ [2.]	$P_{K_i}K_i$ [3.]	$(P_{K_i}+\hat{\theta}_iq_i)K_i$
(1) Owner-Occupied Housing	3524.5	881.13	2720.17	3218.8	433.4	4340.4	1186.83	4405.63
(2) Rented Housing	1022.18	1022.18	1262.26	1493.64	534.98	2347.96	550.72	2044.36
(3) Other Industry	21971.7	5492.92	5335.1	20497.5	9770.94	22073.16	6967.12	27464.62
TOTAL					10739.32			33914.61

Notes:

1. $T_{K_i} \equiv \Pi_i + t_iq_i + u_mr_m\phi_iq_i$

2. $P^*_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_iq_i + (m_i+\delta_i)q_i - \hat{\theta}_iq_i + T_{K_i}$

3. $P_{K_i} \equiv P^*_{K_i} - (m_i+\delta_i)q_i - T_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_iq_i - \hat{\theta}_iq_i$

The following elasticities are chosen, in view of the independent estimates of Reid (1962), Muth (1960), Laidler (1960), Lee (1964), De Leeuw (1971):

$$\eta^D_{11} = \eta^D_{22} = -1.2; \ \eta^M_1 = \eta^M_2 = 1.2$$ [8]

A number of different values of η^D_{33} (ranging from -0.5 to -1) were considered.[9] After some experimentation, a value of $\eta^D_{33} = -.95$ was found to be consistent with a "reasonable" set of values for each of the other elasticities. These elasticities are, on using (3-3-62), (3-3-55)[10]

$$\eta^D_{12} = .4629; \ \eta^D_{21} = .8557; \ \eta^D_{13} = -.4629;$$

$$\eta^D_{31} = -.0142; \ \eta^D_{23} = -.8557; \ \eta^D_{32} = -.0192.$$

$$\eta^M_3 = .9834$$

The final elasticity to be specified is the elasticity of substitution between capital and labour in Sector 3. Results were computed for values of

$$\sigma_3 = 1, \ \sigma_3 = 0.5$$

The results presented in the text use a value of unity. It might be noted that this value has been employed in virtually all studies of the incidence of the corporation income tax (for instance). There is very little evidence to deny it (Klein (1974), for instance).

Canada

Data are from Appendix A-1-1 to Chapter 1, the Yearbook of National Accounts Statistics, 1979 (United Nations), the Government Finance Statistics Yearbook (Vol. V), 1981 (International Monetary Fund), and from the International Financial Statistics (Vol. 32, No. 12), 1979 (International Monetary Fund). Sector 1 capital is owner-occupied residential assets; Sector 2 capital is rented residential assets; and Sector 3 capital is non-residential tangible assets, including non-residential structures, equipment, and inventories, employed in public and private, corporate and unincorporated, enterprises. All data are for 1978.

From Table A-3 of Appendix A-1-1,

(B-42) $$q_1K_1 + q_2K_2 = \$169070 \text{ million.}$$

(B-43) $$q_3K_3 = \$410080 \text{ million.}$$

The 1971 Census of Population and Dwellings revealed that 60.3 percent of occupied dwellings were owner-occupied and 39.7 percent rented (Canada Yearbook, 1976-77). Hence, on using these figures in (B-42) (assuming, implicitly, that $q_1 = q_2$),

(B-44) $$q_1K_1 = \$101949.21 \text{ million}$$

(B-45) $$q_2K_2 = \$67120.79 \text{ million}$$

On using the rates of depreciation employed in Appendix A-1-1, and the data of Table A-3, depreciation by sector is (if $\delta_1 = \delta_2$)[11.]

(B-46) $\delta_1 q_1 K_1$ = \$4077.9684 million,

(B-47) $\delta_2 q_2 K_2$ = \$2684.8316 million,

(B-48) $\delta_3 q_3 K_3$ = \$26445.65 million.

Further, assuming repairs, maintenance, and casualty insurance premiums are one-half of the value of depreciation,[12.]

(B-49) $(\delta_1 + m_1) q_1 K_1$ = \$6116.9526 million,

(B-50) $(\delta_2 + m_2) q_2 K_2$ = \$4027.2474 million,

(B-51) $(\delta_3 + m_3) q_3 K_3$ = \$39668.475 million.

The rate of opportunity cost is approximated by the Government bond yield, which averaged 9.3 percent in 1978.[13.] Further, assume that[14.]

(B-52) $u_1 = u_2 = u_m = 0.2$

(B-53) $\phi_1 = 0.2,\ \phi_2 = 0.4,\ \phi_3 = 0.2$

(B-54) $\hat{\theta} = \hat{\theta}_2 = .03,\ \hat{\theta}_3 = .02$

(B-55) $\hat{\theta}_1 q_1 K_1$ = \$3058.4763 million,

(B-56) $\hat{\theta}_2 q_2 K_2$ = \$2013.6237 million,

(B-57) $\hat{\theta}_3 q_3 K_3$ = \$8201.6 million.

According to Canadian tax law,

$$\text{(B-58)} \quad \Pi_2K_2 = u_2(1-\phi_2)r_cq_2K_2 - \frac{u_2(1-\tfrac{1}{2}\lambda_2u_2)}{(1-u_2)}\hat{\Theta}_2q_2K_2$$

Assuming that one-half of accrued capital gains are actually realised, (B-58) produces:

$$\text{(B-59)} \qquad \Pi_2K_2 = \$270.8324 \text{ million}$$

Further,

$$\text{(B-60)} \qquad \Pi_1K_1 = 0,$$

and assuming all corporate activity belongs to Sector 3, and that one-half of Sector 3 capital gains accrue to corporate enterprises, and one-half to individuals, total income taxes in Sector 3 are:

$$\text{(B-61)} \quad \Pi_3K_3 = 6257+u_3(1-\phi_3)r_cq_3K_3 - \frac{\tfrac{1}{2}u_3(1-\tfrac{1}{2}\lambda_3u_3)}{(1-u_3)}\hat{\Theta}_3q_3K_3$$

$$= \$11385.0504 \text{ million}$$

A one-percent property tax rate (percent of capital value) seems consistent with property tax rates currently levied in Canada. Hence,

$$t_1q_1K_1 = \$1019.4921 \text{ million}$$

$$t_2q_2K_2 = \$671.2079 \text{ million}$$

$$t_3q_3K_3 = \$4100.80 \text{ million.}$$

Estimates of each of the user cost components, for each sector, are presented in Table B-2, on using the data derived above.

TABLE B-2: User Cost Components; Canada; Year Ending 31st December, 1978.

($ million)

Sector	$(1-u_i)r_c(1-\phi_i)q_iK_i$	$(1-u_m)r_m\phi_iq_iK_i$	$(m_i+\delta_i)q_iK_i$	$\hat{\theta}_iq_iK_i$	$T_{K_i}K_i$ [1.]	$C_iK_i=P^*_{K_i}K_i$ [2.]	$P_{K_i}K_i$ [3.]	$(P_{K_i}+\hat{\theta}_iq_i)K_i$
(1) Owner-Occupied Housing	6068.02	1517.00	6116.95	3058.48	1398.74	12042.23	4526.23	7585.02
(2) Rented Housing	2996.27	1997.51	4027.25	2013.62	1441.42	8448.83	2980.16	4993.78
(3) Other Industry	24407.96	6101.99	39668.48	8201.60	17011.35	78988.18	22308.35	30509.95
TOTAL					19851.51			43088.75

Notes:

1. $T_{K_i} \equiv \Pi_i + t_iq_i + u_mr_m\phi_iq_i$

2. $P^*_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_iq_i + (m_i+\delta_i)q_i - \hat{\theta}_iq_i + T_{K_i}$

3. $P_{K_i} \equiv P^*_{K_i} - (m_i+\delta_i)q_i - T_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_iq_i - \hat{\theta}_iq_i$

Total employee compensation amounted to \$131,494 million in 1978.[16] Hence

$$L_3 = 131494.$$

Again, the following elasticities have been chosen:

$$\eta^D_{11} = \eta^D_{22} = -1.2;\ \eta^M_1 = \eta^M_2 = 1.2;\ \eta^D_{33} = -.95.$$

These values imply:

$$\eta^D_{12} = .3611;\ \eta^D_{21} = .5147;\ \eta^D_{13} = -.3611;$$

$$\eta^D_{31} = -.0112;\ \eta^D_{23} = -.5147;\ \eta^D_{32} = -.0153.$$

$$\eta^M_3 = .9764$$

Finally, a unitary elasticity of substitution between capital and labour in Sector 3 has been used in obtaining the results presented in the text.

New Zealand

The principal source of data for the empirical assessment of the implications of the nonneutral taxation of housing capital in New Zealand is the New Zealand Official Yearbook, 1980 (Department of Statistics, Wellington). Estimates of the user cost variables are presented in Table B-3. All data are for the fiscal year to 31 March, 1978,[17] the most recent year for which suitable data are available. The methods used to infer parameter values from official statistics, are detailed below.

In this study, Sector 3 represents an aggregate sector, combining all non-residential economic activity; corporate and unincorporated enterprises, public and private enterprises, are all included.

Total employee compensation in the fiscal year to March 1978 amounted to $8465 million (Yearbook, p.641). Total operating surplus on New Zealand production amounted to $4450 million. Expenses of depreciation, repairs and maintenance, were estimated to be $1196 million.[18.] Operating surplus is defined as "gross output at producer's values less the sum of intermediate consumption, compensation of employees, consumption of fixed capital, and indirect taxes net of subsidies. It is approximately equal to accounting profit before the deduction of direct taxes, dividends, and bad debts and before the deduction of interest paid on the addition of interest received."[19.] In present notation, the operating surplus in Sector i is:

$$\text{(B-62)} \quad P_iQ_i - P_{L_i}L_i - (m_i+\delta_i+t_i)q_iK_i = P^*_{K_i}K_i - (m_i+\delta_i+t_i)q_iK_i$$
$$= \{(1-u_i)r_c(1-\phi_i)+r_m\phi_i-\hat{\theta}_i\}q_iK_i+\Pi_iK_i,$$
$$i=1,2,3.$$

Gross domestic product generated by the ownership of owner-occupied dwellings sector (Sector 1) was estimated to be $581m. in 1977-78. This was made up of an operating surplus of $383m., an estimate of the consumption of fixed capital of $99m., and indirect taxes of $99m. The estimate of the consumption of fixed capital is an estimate of the "value of depreciation at ordinary rates

TABLE B-3: User Cost Components; New Zealand, Fiscal Year Ending 31 March, 1978.

($ million)

Sector	$(1-u_i)r_c(1-\phi_i)q_iK_i$	$(1-u_m)r_m\phi_i q_i K_i$	$(m_i+\delta_i)q_iK_i$	$\hat{\theta}_i q_i K_i$	$T_{K_i}K_i$ [1.]	$C_iK_i=P^*_{K_i}K_i$ [2.]	$P_{K_i}K_i$ [3.]	$(P_{K_i}+\hat{\theta}_i q_i)K_i$
(1) Owner-Occupied Housing	1206.45	517.05	99	718.13	443.7	1548.07	1005.37	1723.5
(2) Rented Housing	369.32	369.32	42.43	307.77	329.69	802.99	430.87	738.64
(3) Other Industry	2345.59	1005.25	1054.57	1116.95	1265.15	4553.61	2233.89	3350.84
TOTAL					2038.54			5812.98

Notes:

1. $T_{K_i} \equiv \Pi_i + t_i q_i + u_m r_m \phi_i q_i$

2. $P^*_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_i q_i + (m_i+\delta_i)q_i - \hat{\theta}_i q_i + T_{K_i}$

3. $P_{K_i} \equiv P^*_{K_i} - (m_i+\delta_i)q_i - T_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_i q_i - \hat{\theta}_i q_i$

allowed for taxation purposes, plus an estimate for the normal rate of accidental damage, based on the insurance claims by each industry group."[20] Hence, it is supposed that

(B-63) $\delta_1 q_1 K_1 + m_1 q_1 K_1 = \$99m.$

Further, the only indirect taxes charged on the output of Sector 1 are local authority rates. Accordingly,

(B-64) $t_1 q_1 K_1 = \$99m.$

The estimate of operating surplus in Sector 1 requires amendment. The value of \$581m. is actually an estimate of the rental that would be earned if K_1 units of owner-occupied housing were let in the private rental market. If it is assumed that the representative rented and owner-occupied dwellings exhibit the same combined rates of repairs, maintenance and depreciation, the same expected rates of capital gain, and the same property tax rates (i.e., $\delta_1 + m_1 = \delta_2 + m_2$; $\hat{\theta}_1 = \hat{\theta}_2$; $t_1 = t_2$), then the estimate of operating surplus in Sector 1 is actually an estimate of

(B-65) $\psi\{(1-u_2)r_c(1-\phi_2) + r_m\phi_2 - \hat{\theta}_2\}q_2K_2 + \psi\Pi_2K_2.$

<u>where</u>: ψ is the ratio of owner-occupied housing units to rented housing units.

The <u>Yearbook</u> (p.487) reveals that in 1976, 69.7 percent of all occupied permanent private dwellings[21.] were owner-occupied. No later estimate is available. Here, it is supposed that $\psi = .7/.3 = 2.\dot{3}$. Then,

(B-66) $\{(1-u_2)r_c(1-\phi_2)+r_m\phi_2-\hat{\theta}_1\}q_1K_1 = 383-2.3\Pi_2K_2.$

Π_2K_2 represents total income taxes levied on rented housing. According to New Zealand tax legislation in force in 1978 (Section 2.2, Chapter 2):

(B-67) $\Pi_2K_2 = \frac{u_2}{1-u_2}\{(1-u_2)r_c(1-\phi_2)-\hat{\theta}_2\}q_2K_2,$

on using (4-1-5). There are no data available concerning ϕ_i, $\hat{\theta}_i$, or the tax rates of individual asset owners, u_m and u_i. Here, it is supposed that:

(i) $r_c = 4\hat{\theta}_1 = 4\hat{\theta}_2 = 5\hat{\theta}_3.$

(ii) $\phi_1 = .3;\ \phi_2 = .5;\ \phi_3 = .3$

(iii) $u_m = u_i = .4,$ $i=1,2,3.$

The implications of (i) might be illustrated with a simple example: Hence, if the nominal net rate of return on capital is 20% per annum, housing generates expected capital gains at a rate of 5% per annum, while assets employed in Sector 3 are expected to appreciate at a lower rate of 4% per annum. (ii) suggests "reasonable" debt/equity ratios for each asset. And (iii) says that the average rate of tax on investment income (excluding accrued capital gains) is 40 percent. These assumptions imply:

(B-68) $$\Pi_2K_2 = \frac{.4}{.6}(.05)r_cq_2K_2.$$
$$= .03r_cq_2K_2$$

(i) to (iii) in (B-66) imply, on using (B-68) and the capital market equilibrium condition that $r_c = r_m$:

(B-69) $r_c q_1 K_1 = \$2872.5$ million;

(B-70) $\hat{\theta}_1 q_1 K_1 = \$718.13$ million.

(B-71) $\Pi_2 K_2 = \$41.04$ million.

(B-72) $r_c q_2 K_2 = \$1231.07$ million.

(B-73) $\hat{\theta}_2 q_2 K_2 = \$307.77$ million.

(B-74) $r_m \phi_1 q_1 K_1 = \$861.75$ million;

(B-75) $r_m \phi_2 q_2 K_2 = \$615.54$ million;

(B-76) $t_2 q_2 K_2 = \$42.43$ million.

Total rates payments plus other taxes and fines paid to territorial local authorities[22.] in the fiscal year 1977-78 amounted to \$291.6m. (<u>Yearbook</u> p.702). Hence:

(B-77) $t_3 q_3 K_3 = \$(291.6-99-42.43)\text{m.}$
$= \$150.17\text{m.}$

Furthermore, since $\delta_1 + m_1 = \delta_2 + m_2$, by assumption,

(B-78) $(\delta_2+m_3)q_2K_2 = \frac{3}{7}(\delta_1+m_1)q_1K_1 = \$42.43\text{m.}$

and

(B-79) $(\delta_3+m_3)q_3K_3 = \$(1196-99-42.43)\text{m.}$
$= \$1054.57\text{m.}$

Since total operating surplus is \$4450m., (B-80) $$(1-u_3)r_c(1-\phi_3)q_3K_3 + r_m\phi_3q_3K_3 - \hat{\Theta}_3q_3K_3 + \Pi_3K_3$$

$$= 4450-383-\{(1-u_2)r_c(1-\phi_2)q_2K_2 + r_m\phi_2q_2K_2$$

$$-\hat{\Theta}_2q_2K_2 + \Pi_2K_2\}$$

$$= \$3348.87 \text{ million.}$$

Total taxes actually collected from incomes amounted to \$3428.8 million in the fiscal year 1977-78 (Yearbook pp.673, 674, 681, 682). These total tax receipts are to be allocated among labour and capital in each sector. Total income taxes on labour are estimated by taking the average rate of income tax on wage and salary earners in the year 1975-76, the latest year for which this datum is available. Applying this rate to the estimate of total employee compensation, total income taxes on labour are found to be:

$$.205065 \times 8465 = \$1735.87 \text{ million.}$$

Since there are no income taxes levied on owner-occupied housing, taxes are

(B-81) $$\Pi_3K_3 + 41.04 + 1735.87 + u_mr_m(\phi_1q_1K_1+\phi_2q_2K_2$$

$$+\phi_3q_3K_3) = 3482.8$$

$u_mr_m(\phi_1q_1+\phi_2q_2K_2+\phi_3q_3K_3)$ is total tax payments on mortgage interest. (B-81) in (B-80) gives:

(B-82) $$(1-u_3)r_c(1-\phi_3)q_3K_3 + (1-u_m)r_m\phi_3K_3 - \hat{\Theta}_3q_3K_3$$

$$- u_mr_m\phi_1q_1K_1 - u_mr_m\phi_2q_2K_2 = 1642.98,$$

which, on using (B-74), (B-75), provides, (B-83) $r_c q_3 K_3 = \$5584.74$ million.

Then,

(B-84) $\phi_3 q_3 K_3 = \$1116.95$ million,

(B-85) $r_m \phi_3 q_3 K_3 = \$1675.42$ million,

(B-86) $\Pi_3 K_3 = \$444.81$ million.

Again, the following elasticities were chosen:

$$\eta^D_{11} = \eta^D_{22} = -1.2; \ \eta^M_1 = \eta^M_2 = 1.2; \ \eta^D_{33} = -.95$$

The values imply[23].

$$\eta^D_{12} = .2255; \ \eta^D_{21} = 4348; \ \eta^D_{13} = -.2255;$$

$$\eta^D_{31} = -.0028; \ \eta^D_{23} = -.4348; \ \eta^D_{32} = -.0135.$$

$$\eta^M_3 = .9663$$

As in the Australian study, a value of $\sigma_3 = 1$ has been used to obtain the New Zealand estimates presented in the text.

The United Kingdom

Data are for the year ending 31 December, 1978. Principal data sources are: United Kingdom, National Income and Expenditure, 1979, United Nations, Yearbook of National Accounts Statistics, 1979, International Monetary Fund, Government Finance Statistics Yearbook, Vol. V., 1981, and C.S.O., Annual Abstract of Statistics, 1980.

Gross domestic product generated by owner-occupied housing is

(B-87) $$(1-u_1)r_c(1-\phi_1)q_1K_1+r_m\phi_1q_1K_1+\delta_1q_1K_1-\hat{\Theta}_1q_1K_1+\Pi_1K_1$$
$$= £\,5352 \text{ million.}$$ [24]

Assuming the same exponential rate of depreciation on owner-occupied, and rented, housing,

(B-88) $\delta_1q_1K_1 = £\,1155.06$ million[25]

At the end of 1978, the net current replacement cost of dwellings, excluding local authority dwellings, was 95200 million.[26] Of this, the value of owner-occupied housing was

(B-89) $q_1K_1 = £\,77112$ million.[27]

The average individual rate of tax on capital income is assumed to be

(B-90) $u_1 = u_3 = u_m = .18$[28]

According to United Kingdom tax legislation,

(B-91) $\Pi_1K_1 = u_1r_m\phi_1q_1K_1.$

(B-88), (B-91) in (B-87) reveal (if $r_c = r_m$)

(B-92) $(1-u_1)r_cq_1K_1-\hat{\Theta}_1q_1K_1 = £\,4196.94$ million.

Assuming an opportunity (equals mortgage) rate of interest of 12 percent,[29]

(B-93) $r_cq_1K_1 = £9253.44$ million,

and

(B-94) $\hat{\Theta}_1 q_1 K_1 = £3390.88$ million.

(B-94) implies $\hat{\Theta}_1 = 4.4$ percent per annum.

As for the other countries, it has been assumed that

(B-95) $\phi_1 = 0.2$

Thence,

(B-96) $(1-u_1)r_c(1-\phi_1)q_1K_1 = £6070.26$ million

(B-97) $(1-u_m)r_m\phi_1 q_1 K_1 = £1517.56$ million

(B-98) $\Pi_1 K_1 = -£333.12$ million.

Assuming a property tax rate of

(B-99) $t_1 = .01$,

(B-100) $T_{K_1}K_1 = t_1q_1K_1+\Pi_1K_1+u_mr_m\phi_1q_1K_1 = £\,771.12$ million.

Lastly, suppose $m_1 = .5\delta_1$.[30] Then

(B-101) $(m_1+\delta_1)q_1K_1 = £\,1732.59$ million.

The user cost of local authority housing is

(B-102) $C_4 = \{r_c(1-\phi_4)+r_m\phi_4+m_4+\delta_4-\hat{\Theta}_4\}q_4K_4+\Pi_4K_4$.

Income taxes are:

(B-103) $\Pi_4K_4 = -(r_c-r_4)(1-\phi_4)q_4K_4$

<u>where</u>: $(r_c-r_4)(1-\phi_4)q_4K_4$ is the interest rate subsidy. i.e., it is the difference between the return on $(1-\phi_4)q_4K_4$ dollars of equity in the market, less the return earned by local authorities.

The user cost in (B-102) is met by rental payments of £2690 million.[31] Hence,

(B-104) $$r_4(1-\phi_4)q_4K_4+r_m\phi_4q_4K_4+(m_4+\delta_4)q_4K_4-\hat{\Theta}_4q_4K_4 = £2690 \text{ million.}$$

Now

(B-105) $$r_m\phi_4q_4K_4 = £1880 \text{ million}$$[32]

(B-106) $$m_4q_4K_4 = £636 \text{ million}$$[33]

(B-107) $$\delta_4q_4K_4 = £700 \text{ million}$$[34]

(B-108) $$q_4K_4 = £58700 \text{ million}$$[35]

$r_m = .12$ implies (from (B-105), (B-108))

(B-109) $$\phi_4 = .26689$$

If $\hat{\Theta}_4 = \hat{\Theta}_1$,

(B-110) $$\hat{\Theta}_4q_4K_4 = £2582.80 \text{ million}$$

(B-105), (B-106), (B-107), (B-109), (B-110) in (B-104) imply

(B-111) $$r_4(1-\phi_4)q_4K_4 = £2056.80 \text{ million}$$

(B-112) $$r_4 = .047795$$

(B-113) $$(r_c-r_4)(1-\phi_4)q_4K_4 = £3107.237983 \text{ million.}$$

Now,

(B-114) $$T_{K_4}K_4 = u_mr_m\phi_4q_4K_4+\Pi_4K_4 = -£2768.84 \text{ million.}$$

Further, $u_4 = 0$, so that

(B-115) $(1-u_4)r_c(1-\phi_4)q_4K_4$ = £5164.03 million.

(B-116) $(1-u_m)r_m\phi_4q_4K_4$ = £1541.61 million.

Income taxes on capital employed in Sector 3 (other industry) are:

(B-117) $$\Pi_3K_3 = 3807+u_3(1-\phi_3)r_cq_3K_3-\frac{.5u_3(1-.3\lambda_3)\hat{\Theta}_3q_3K_3}{1-u_3}$$

where £3807 million is corporation income taxes,[36.] and it is assumed that one-half of Sector capital gains accrue to individuals.

Now,

(B-118) q_3K_3 = £356,600 million[37.]

(B-119) $\delta_3q_3K_3$ = £ 16184 million[38.]

Assuming that $\phi_3 = 0.2$,[39.]

(B-120) $r_cq_3K_3$ = £ 42792 million

(B-121) $u_3(1-\phi_3)r_cq_3K_3$ = £ 6162.05 million

Further, assuming that capital gains on non-residential property accrue at half the rate at which capital gains accrue on residential property (i.e., $\hat{\Theta}_3 = .022$), and that one-half of accrued capital gains are realised

(B-122) $\hat{\Theta}_3q_3K_3$ = £ 7845.2 million

(B-123) Π_3K_3 = £ 9237.15 million

And, if $t_3 = t_1 = .01$,

(B-124) $t_3q_3K_3$ = £3566 million

Hence

(B-125) $T_{K_3}K_3 = 3566 + 9237.15 + u_m r_m \phi_3 q_3 K_3$

$= £13830.16$ million

(B-126) $(1-u_3)r_c(1-\phi_3)q_3K_3$ = £28071.55 million

(B-127) $(1-u_m)r_m\phi_3q_3K_3$ = £7017.89 million.

Lastly, assuming $m_3 = .5\delta_3$,

(B-128) $(m_3+\delta_3)q_3K_3$ = £ 24276 million.

The estimates derived here are presented in Table B-4.

Labour employment in Sector 3 is

$L_3 = 98423$[40].

Although a significant amount of sensitivity analysis was performed (see Section 4.3), the estimates presented in the text employ the following elasticities:

$$\eta^D_{11} = \eta^D_{22} = -1.2;\ \eta^M_1 = \eta^M_2 = 1.2;\ \eta^D_{33} = -.95.$$

These values imply:[41]

$$\eta^D_{12} = .5606;\ \eta^D_{21} = 1.3964;\ \eta^D_{31} = -.0161;$$

$$\eta^D_{13} = -.5606;\ \eta^D_{23} = -1.3964;\ \eta^D_{32} = -.0214;$$

$$\eta^M_3 = .9875$$

Further, it is assumed that $\sigma_3 = 1$.

TABLE B-4: User Cost Components; United Kingdom; Year Ending 31 December 1978.

(£ million)

Sector	$(1-u_i)r_c(1-\phi_i)q_iK_i$	$(1-u_m)r_m\phi_i q_i K_i$	$(m_i+\delta_i)q_iK_i$	$\hat{\Theta}_i q_i K_i$	$T_{K_i}K_i$ [1.]	$C_iK_i=P^*_{K_i}K_i$ [2.]	$P_{K_i}K_i$ [3.]	$(P_{K_i}+\hat{\Theta}_i q_i)K_i$
(1) Owner-Occupied Housing	6070.26	1517.56	1732.59	3390.88	771.12	6700.65	4196.94	7587.82
(2) Local Authority Housing	5164.03	1541.61	1336.00	2582.80	-2768.84	2690.00	4122.84	6705.64
(3) Other Industry	28071.55	7017.89	24276.00	7845.20	13830.16	65350.40	27244.24	35089.44
TOTAL					11832.44			49382.90

Notes:

1. $T_{K_i} \equiv \Pi_i + t_i q_i + u_m r_m \phi_i q_i$

2. $P^*_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_i q_i + (m_i+\delta_i)q_i - \hat{\Theta}_i q_i + T_{K_i}$

3. $P_{K_i} \quad P^*_{K_i} - (m_i+\delta_i)q_i - T_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_i q_i - \hat{\Theta}_i q_i$

The United States

The estimates developed here use data from Rosenberg (1969). Data are averages for the period 1953-59.

Rosenberg (1969) computes estimates of the return on equity capital, monetary interest payments, property taxes, income taxes, and capital gains, for nine non-financial industry groups: Farming, agricultural services, forestry, and fishing; Mining; Contract construction; Manufacturing; Wholesale and retail trade; Real estate; Transport; Communications and public utilities; services. The estimations reported here ignore farming, agricultural services, forestry, and fishing. Real estate comprises the rented and owner-occupied housing sectors, while the other seven industry groups make up Sector 3, "other private non-farm."

Rosenberg's data are used to obtain estimates for $r_c(1-\phi_i)q_iK_i$, $r_m\phi_iq_iK_i$, $\delta_iq_iK_i$, $\hat{\Theta}_iq_iK_i$, $t_iq_iK_i$, $m_iq_iK_i$, Π_iK_i, and $T_{K_i}K_i$, for each sector.

Estimates of the relevant aggregates are presented in Table B-5. The techniques used to obtain these estimates are described below:

(a) Sectors 1 and 2: Owner-occupied, and Rented, Housing:

Column 1 of Table 1 of Rosenberg (1969) presents an estimate of corporate net profits before corporate profits tax and local property tax payments, by industry group. Column 7 presents an analogous estimate for unincorporated enterprise. The estimates for real estate reveal:

TABLE B-5: User Cost Components; United States; Average 1953-59.

($ million)

Sector	$(1-u_i)r_c(1-\phi_i)q_iK_i$	$(1-u_m)r_m\phi_i q_i K_i$	$(m_i+\delta_i)q_iK_i$	$\hat{\theta}_i q_i K_i$	$T_{K_i}K_i$ [1.]	$C_iK_i=P^*_{K_i}K_i$ [2.]	$P_{K_i}K_i$ [3.]	$(P_{K_i}+\hat{\theta}_i q_i)K_i$
(1) Owner-Occupied Housing	5940.33	1485.08	5395.03	2480.04	2644.07	12984.47	4945.37	17929.84
(2) Rented Housing	1461.88	2714.91	3034.7	1395.02	2794.57	8611.04	2781.77	11392.81
(3) Other Industry	15178.27	3794.57	27413.15	2613.3	27794.46	71567.15	16359.54	87926.69
TOTAL					33233.10			117249.34

Notes:

1. $T_{K_i} \equiv \Pi_i + t_i q_i + u_m r_m \phi_i q_i$

2. $P^*_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_i q_i + (m_i+\delta_i)q_i - \hat{\theta}_i q_i + T_{K_i}$

3. $P_{K_i} \quad P^*_{K_i} - (m_i+\delta_i)q_i - T_{K_i} = (1-u_i)r_c(1-\phi_i)q_i + (1-u_m)r_m\phi_i q_i - \hat{\theta}_i q_i$

(B-129) $$P^*_{K_1}K_1 - r_m\phi_1 q_1 K_1 - (m_i+\delta_1)q_1K_1 + P^*_{K_2}K_2 - r_m\phi_2 q_2 K_2 - (m_2+\delta_2)q_2K_2 = \$8157 \text{ million.}$$

Column 4 of Table 1 of Rosenberg (1969) reveals:

(B-130) $$r_m\phi_1 q_1 K_1 + r_m\phi_2 q_2 K_2 = \$5250 \text{ million.}$$

(B-129) can be written

(B-131) $$(1-u_1)r_c(1-\phi_1)q_1K_1 + t_1q_1K_1 - \hat{\Theta}_1 q_1K_1 + \Pi_1K_1 + (1-u_2)r_c(1-\phi_2)q_2K_2 + t_2q_2K_2 - \hat{\Theta}_2 q_2K_2 + \Pi_2K_2 = \$8157 \text{ million.}$$

Table 11 of Rosenberg (1969) reveals that

(B-132) $$t_1q_1K_1 + t_2q_2K_2 = \$4922 \text{ million.}$$

Column 2 of Table 1 of Rosenberg (1969) presents estimates of net realised capital gains by corporate enterprise industry. For real estate, this value is \$100 million. Realised capital gains on housing are estimated to be $100 \times \frac{8157}{421} = \$1937.53$ million. 8157/421 is the ratio of total to corporate net income of real estate. Evidence from the Statistical Abstract of the United States, 1958 (p.760) reveals that approximately 64 percent of non-farm dwellings were owner-occupied in 1956. Hence (since it is assumed that $q_1 = q_2$),

(B-133) $$q_1K_1 = \frac{.64}{.36}q_2K_2$$

If it is assumed that $\hat{\theta}_1 = \hat{\theta}_2$, realised capital gains by residential sector are:

(B-134) $\lambda_1\hat{\theta}_1 q_1 K_1 = \$1240.02$ million.

(B-135) $\lambda_2\hat{\theta}_2 q_2 K_2 = \$697.51$ million.

Assuming that one-half of all capital gains are actually realised, so that $\lambda_1 = \lambda_2 = \lambda_3 = .5$, permits:

(B-136) $\hat{\theta}_1 q_1 K_1 = \$2480.04$ million,

(B-137) $\hat{\theta}_2 q_2 K_2 = \$1395.02$ million.

Furthermore, on using (B-133) in (B-132),

(B-138) $t_1 q_1 K_1 = \$3150.08$ million,

(B-139) $t_2 q_2 K_2 = \$1771.92$ million,

assuming that $t_1 = t_2$.

(B-136) to (B-139) in (B-131) reveals

(B-140) $$(1-u_1)r_c(1-\phi_1)q_1K_1+(1-u_2)r_c(1-\phi_2)q_2K_2$$
$$+\Pi_1K_1+\Pi_2K_2 = \$7110.06 \text{ million}$$

Π_2K_2 represents both corporate and individual taxes on the income of Sector 2. i.e.,

(B-141) $\Pi_2K_2 = \Pi_2^cK_2^c+\Pi_2^uK_2^u$

Rosenberg calculates that corporate income taxes on non-farm residential dwellings were \$218 million. Since all corporate housing is rented, total income taxes on corporate rented housing are:

(B-142) $$\Pi_2^c K_2^c = 218 + u_2 r_c (1-\phi_2^c) q_2 K_2^c$$

According to United States tax legislation, described in Section 2.2, income taxes on unincorporated rented housing are, on using (3-1-4):

(B-143) $$\Pi_2^u K_2^u = u_2 r_c (1-\phi_2^u) q_2 K_2^u - \frac{u_2 (1-.25) \hat{\Theta}_2 q_2 K_2^u}{1-u_2}$$

Assuming that $\phi_2^c = \phi_2^u$, (B-142), (B-143) in (B-141) reveals:

(B-144) $$\Pi_2 K_2 = 218 + u_2 r_c (1-\phi_2) q_2 K_2 - .75 (\frac{u_2}{1-u_2}) \hat{\Theta}_2 q_2 K_2^u$$

Table 1 of Rosenberg (1969) reveals that

(B-145) $$(1-u_2) r_c (1-\phi_2^c) q_2 K_2^c + t_2 q_2 K_2^c + \Pi_2^c K_2^c$$

$$= \$521 \text{ million.}$$

(B-142) in (B-145) produces:

(B-146) $$r_c (1-\phi_2^c) q_2 K_2^c + t_2 q_2 K_2^c = \$303 \text{ million.}$$

Hence:

(B-147) $$q_2 K_2^c = \frac{303}{(r_c (1-\phi_2^c) + t_2)},$$

and

(B-148) $$q_2 K_2^u = q_2 K_2 - q_2 K_2^c = q_2 K_2 - \frac{303}{r_c (1-\phi_2^c) + t_2}$$

(B-148) in (B-144) produces:

$$\Pi_2 K_2 = 218 + u_2 r_c (1-\phi_2) q_2 K_2 - .75 (\frac{u_2}{1-u_2}) \hat{\Theta}_2 q_2 K_2$$

$$+ \frac{.75 (\frac{u_2}{1-u_2}) 303 \hat{\Theta}_2 q_2 K_2}{r_c (1-\phi_2) q_2 K_2 + t_2 q_2 K_2},$$

which, on using (B-137), (B-139) reveals:

(B-149) $$\Pi_2K_2 = 218 + u_2r_c(1-\phi_2)q_2K_2-(\frac{u_2}{1-u_2})1046.265 + \frac{(\frac{u_2}{1-u_2})317018.295}{1771.92+r_c(1-\phi_2)q_2K_2}$$

According to United States tax legislation

(B-150) $$\Pi_1K_1 = -u_1\{r_m\phi_1q_1K_1+t_1q_1K_1\}+\tfrac{1}{2}u_1\lambda_1\hat{\theta}_1q_1K_1$$

$$= -u_1\{r_m\phi_1q_1K_1+3150.08\}+u_1620.01$$

(B-149), (B-150) in (B-140) reveals:

(B-151) $$(1-u_1)r_c(1-\phi_1)q_1K_1 + r_c(1-\phi_2)q_2K_2$$

$$+ 218 -(\frac{u_2}{1-u_2})1046.265+\frac{(\frac{u_2}{1-u_2})317018.295}{1771.92+r_c(1-\phi_2)q_2K_2}$$

$$-u_1r_m\phi_1q_1K_1 - u_13150.08 + 620.01u_1$$

$$= \$7110.06 \text{ million.}$$

It is assumed that

(B-152) $$u_1 = u_2 = u_3 = u_m = .20.$$

On using (B-152) and the capital market equilibrium condition that $r_c = r_m$, in (B-151):

(B-153) $$r_cq_1K_1(1.3625-\phi_1-.5625\phi_2)$$

$$+ \frac{79254.57375}{1771.92+r_cq_1K_1(.5625-.5625\phi_2)}$$

$$= 7659.64025.$$

But (B-130) reveals:

$$\text{(B-154)} \qquad r_c q_1 K_1 = \frac{5250}{\phi_1 + .5625\phi_2}$$

(B-154) in (B-153) produces:

$$\text{(B-155)} \qquad \frac{5250(1.3625 - \phi_1 - .5625\phi_2)}{\phi_1 + .5625\phi_2}$$

$$+ \frac{79254.57375(\phi_1 + .5625\phi_2)}{1771.92(\phi_1 + .5625\phi_2) + 2953.125(1-\phi_2)}$$

$$= 7659.64025$$

Data presented in Table 8 of Rosenberg (1969) reveal that

$$\frac{\{P^*_{K_1} - (m_1+\delta_1)q_1\}K_1}{\{P^*_{K_1} - (m_1+\delta_1)q_1\}K_1 + \{P^*_{K_2} - (m_2+\delta_2)q_2\}K_2}$$

$$= \frac{5333}{7510} = .71$$

Hence:

$$.29\{(1-u_1)r_c(1-\phi_1)q_1K_1 + t_1q_1K_1 - \hat{\Theta}_1q_1K_1 + \Pi_1K_1$$

$$= .71\{(1-u_2)r_c(1-\phi_2)q_2K_2 + t_2q_2K_2 - \hat{\Theta}_2q_2K_2 + \Pi_2K_2 \;,$$

which, on using (B-154), (B-136), (B-138), (B-150) produces:

$$\text{(B-156)} \qquad \frac{5250(-.167375-.29\phi_1+.399375\phi_2)}{\phi_1+.5625\phi_2}$$

$$= 189.0994225+\frac{56270.74736(\phi_1+.5625\phi_2)}{1771.92(\phi_1+.5625\phi_2)+2953.125(1-\phi_2)}$$

(B-155) and (B-156) provide two independent equations with which to determine values for ϕ_1 and ϕ_2. These equations are approximately satisfied by

(B-157) $\quad \phi_1 = .20$

(B-158) $\quad \phi_2 = .65$

Then, from (B-154),

(B-159) $\quad r_c q_1 K_1 = \$9281.77$ million

(B-160) $\quad r_c q_2 K_2 = \$5220.99$ million.

Hence:

(B-161) $\quad (1-u_1) r_c (1-\phi_1) q_1 K_1 = \$5940.33$ million.

(B-162) $\quad (1-u_2) r_c (1-\phi_2) q_2 K_2 = \$1461.88$ million.

(B-163) $\quad (1-u_m) r_m \phi_1 q_1 K_1 = \$1485.08$ million.

(B-164) $\quad (1-u_m) r_m \phi_2 q_2 K_2 = \$2714.91$ million.

(B-165) $\quad \Pi_1 K_1 = -\$877.2848$ million.

(B-166) $\quad \Pi_2 K_2 = \$343.92$ million.

(B-167) $\quad T_{K_1} K_1 = \$2644.07$ million.

(B-168) $\quad T_{K_2} K_2 = \$2794.57$ million.

It is assumed that:

(B-169) $\delta_1 = \delta_2 = .375r_c$

(B-170) $m_1 = m_2 = .55\delta_1 = .55\delta_2$.

These values are consistent with those employed by Laidler (1969). They imply:

(B-171) $\delta_1 q_1 K_1 = \$3480.66$ million

(B-172) $\delta_2 q_2 K_2 = \$1957.87$ million

(B-173) $m_1 q_1 K_1 = \$1914.37$ million

(B-174) $m_2 q_2 K_2 = \$1076.83$ million

(b) <u>Sector 3: "Other Private Non-Farm"</u>

Data provided by Rosenberg (1960, Table 1) reveal that

(B-175) $P^*_{K_3} K_3 - r_m \phi_3 q_3 K_3 - (m_3 + \delta_3) q_3 K_3 = \$39427$ million.

Mortgage interest payments are:

(B-176) $r_m \phi_3 q_3 K_3 = \$4727$ million.

Table 14 of Rosenberg (1969) reveals that property taxes are:

(B-177) $t_3 q_3 K_3 = \$5080$ million.

Total income taxes are:

(B-178) $\Pi_3 K_3 = \Pi_3^c K_3^c + \Pi_3^u K_3^u$

Corporate income taxes are \$18,024 million. To this must be added $u_3 r_c(1-\phi_3^c)q_3 K_3^c$, individual income taxes on corporate equity, to obtain $\Pi_3^c K_3^c$. i.e.,

$$\Pi_3^c K_3^c = 18024 + u_3 r_c (1-\phi_3^c) q_3 K_3^c. \tag{B-179}$$

Taxes on unincorporated income in Sector 3 are, on using (3-1-4):

$$\Pi_3^u K_3^u = u_3 r_c (1-\phi_3^u) q_3 K_3^u - \frac{u_3}{1-u_3}(1-.25)\hat{\theta}_3 q_3 K_3^u. \tag{B-180}$$

If it is assumed that $\phi_3^u = \phi_3^c$, then

$$\Pi_3 K_3 = 18024 + u_3 4_c (1-\phi_3) q_3 K_3 - .75\left(\frac{u_3}{1-u_3}\right)\hat{\theta}_3 q_3 K_3^u. \tag{B-181}$$

Capital gains are estimated as for housing. Rosenberg estimates realised capital gains on corporate Sector 3 capital to be \$1166 million. The estimate for total realised capital gains in Sector 3 is

$$\lambda_3 \hat{\theta}_3 q_3 K_3 = 1166 \times \frac{39427}{35183} = \$1,306.65 \text{ million}. \tag{B-182}$$

\$39427 million is the total net income of Sector 3, while \$35183 million is the corporate net income in Sector 3. Since it is assumed that one-half of capital gains are realised:

$$\hat{\theta}_3 q_3 K_3 = \$2613.3 \text{ million} \tag{B-183}$$

Further,

$$\hat{\theta}_3 q_3 K_3^u = \$281.3 \text{ million}. \tag{B-184}$$

Hence,

(B-185) $\Pi_3 K_3 = u_3 r_c (1-\phi_3) q_3 K_3 + 17971.25625$

(B-175) can be written:

(B-186) $(1-u_3) r_c (1-\phi_3) q_3 K_3 + t_3 q_3 K_3 - \hat{\Theta}_3 q_3 K_3 + \Pi_3 K_3$

$= \$39427$ million.

(B-177), (B-183), (B-185), in (B-186) reveals:

(B-187) $r_c (1-\phi_3) q_3 K_3 = \$18989.04$ million.

Combining (B-187), (B-176) reveals that if $r_c = r_m$,

(B-188) $\phi_3 = 19.93$

This implies a debt/equity ratio of approximately 25 percent (.1993÷.8007), practically the same as for owner-occupied, but smaller than for rented, housing (.65÷.35 = 186 percent). In part this must reflect the wider variety of fund sources open to corporate enterprises for investment purposes. In particular, the role of retained earnings in investment funding has received some attention: Coen (1971), for instance.[42.] Nevertheless, as Tambini (1969) has noted, since the corporation income tax raises the cost of equity above the cost of debt, the result is peculiar. Tambini's explanation of the remarkably low debt/equity ratio appeals to the risk associated with debt financing: Differential degrees of risk equate the marginal costs of debt and equity, even though average costs differ.

Non-residential assets typically depreciate more rapidly than residential assets: The exponential decay factors employed in the Appendix to Chapter 1 imply:

$$1.375 \leq \frac{\delta_3}{\delta_1} = \frac{\delta_3}{\delta_2} \leq 2.875,$$

depending upon the type of non-residential asset. Here, it is assumed that $\delta_3 = 2\delta_1 = 2\delta_2$; $m_3 = .55\delta_3$. These assumptions imply:

(B-189) $\quad \delta_3 q_3 K_3 = \$17630.28$ million.

(B-190) $\quad m_3 q_3 K_3 = \$9782.87$ million.

Furthermore:

(B-191) $\quad (1-u_3) r_c (1-\phi_3) q_3 K_3 = \$15178.27$ million.[43]

(B-192) $\quad (1-u_m) r_m \phi_3 q_3 K_3 = \$3794.57$ million

(B-193) $\quad \Pi_3 K_3 = \$21765.82$ million

(B-194) $\quad T_{K_3} K_3 = \$27794.46$ million.

As to labour income, Harberger (1962) uses a "plausible" value of $\Theta_{K_3} = 0.2$. This implies that

$$L_3 = 286268.6 .$$

The estimates presented in the text employ the following elasticities (employed in the other studies):

$$\eta_{11}^D = \eta_{22}^D = -1.2; \; \eta_1^M = \eta_2^M = 1.2; \; \eta_{33}^D = -.95$$

These values imply:[44]

$$\eta_{12}^{D} = .6325;\ \eta_{21}^{D} = .9537;\ \eta_{31}^{D} = -.0171;$$

$$\eta_{13}^{D} = 0.6325;\ \eta_{23}^{D} = -.9537;\ \eta_{32}^{D} = -.0198;$$

$$\eta_{3}^{M} = .9869$$

Further, the estimates presented in the text assume $\sigma_3 = 1$.

Footnotes to Appendix B-4-2:

1. Australian National Accounts, National Income and Expenditure, 1976-77, p.86.

2. Less than 3 percent of the gross operating surplus of ownership of dwellings is obtained by companies and public enterprises, combined.

3. Approximately one-half of Sector 3 gross operating surplus comes from companies.

4. Including employer contributions to insurance schemes.

5. As Section 2.2 revealed, the deduction has since been withdrawn for all owner-occupiers.

6. Hence, it is supposed that the $300 limit does not affect the representative owner-occupier and that the total concessional deductions exceed $1350.

7. These values are consistent with United States figures obtained below.

8. Section 4.3 presents the results of sensitivity analysis on these parameters.

9. See the sensitivity analysis of Section 4.3.

10. Correct to 4 decimal places.

11. The United Nations, Yearbook of National Accounts Statistics, 1979 reports a value of $25146 million for total depreciation, based on allowances for tax purposes. The estimate obtained here is a total of $33208.45 million.

12. This is consistent with figures used by Laidler (1969) for the United States, and by Reece (1975) for Australia.

13. International Monetary Fund, International Financial Statistics, December, 1979.

14. The values used here imply a gross value-added due to owner-occupied housing of \$8983.76 million. This compares with the official estimate of \$7176 million presented in the United Nations, _Yearbook of National Accounts Statistics, 1979_. The larger estimate obtained here is partly explicable in terms of the larger depreciation provisions permitted here.

15. The figure of 6257 is the estimate of corporate income taxes presented in the _International Monetary Fund, Government Finance Statistics Yearbook, Vol. V., 1981_, p.125.

16. _United Nations, Yearbook of National Accounts Statistics, 1979_.

17. This is before the introduction of the mortgage interest rebate, examined in Chapter 2.

18. Casualty insurance premiums form part of user cost (see Chapter 2), but are ignored here.

19. _Yearbook_, p.640.

20. _Yearbook_, p.639.

21. i.e., excluding hotels, motels, hospitals, and the like.

22. Non-territorial local authorities include drainage boards, electric power boards, harbour boards, and so on.

23. Correct to 4 decimal places.

24. The figure is obtained from _United Nations, Yearbook of National Accounts Statistics, 1979, Vol. 1._, p.1411.

25. _United Kingdom, National Income and Expenditure, 1979_, Table 11.9.

26. ibid., Table 11.11.

27. King and Atkinson (1980) indicate that approximately 81 percent of housing other than local authority housing was owner-occupied at the end of 1978.

28. Individual tax payments as a percentage of total individual incomes were .14 in 1978: C.S.O. Annual Abstract of Statistics, 1980, p.346 reports total individual tax payments of £ 19,672 million, and total before tax income of £ 143,213 million.

29. This is the figure favoured by King and Atkinson (1980).

30. This is consistent with values employed for other countries.

31. Local Authority tenants pay £1,389 million. Rent rebates and explicit excise subsidies add a further £1,777 million. £ 431 million is paid for supervision and management, and £45 million on other current expenditure. The return to capital employed in local authority housing is (1389 + 1777 - 431 - 45 =) £2690 million. All figures are from United Kingdom, National Income and Expenditure, 1979, Table 8.3.

32. United Kingdom, National Income and Expenditure, 1979, Table 8.3.

33. ibid., Table 8.3.

34. ibid., Table 11.9.

35. ibid., Table 11.11.

36. C.S.O., Annual Abstract of Statistics, 1980, p.347.

37. United Kingdom, National Income and Expenditure, 1979, Table 11.11.

38. ibid., Table 11.9.

39. This is consistent with values employed for other countries.

40. Compensation of employees is £98,423 million in 1978: United Nations, Yearbook of National Accounts Statistics, 1979, Vol. 1., p.1410.

41. Correct to 4 decimal places.

42. Retained earnings are ignored here, however.

43. Here, and below, the value of ϕ_3 has been rounded to 0.2.

44. Correct to 4 decimal places.

CHAPTER FIVE

IMPLICATIONS FOR INTERMEDIATE-RUN GROWTH

Previous chapters have explored the comparative static implications of the non-neutral taxation of housing capital. Comparative statics ignores the process of adjustment between equilibria. The process of adjustment is of some interest, however. This chapter presents a preliminary investigation of this process, in the context of tax policy disturbances.

5.1 RESOURCE ALLOCATION AND INTERMEDIATE-RUN GROWTH

Denison (1967), (1974), and others, identify a large number of factors which contribute to economic growth. In general, the studies imply

$$\text{(5-1-1)} \qquad \frac{\Delta M(\tau)}{M(\tau-1)} = \sum_i \lambda_i(\tau-1)\Delta L_i(\tau)/L_i(\tau-1) + \sum_i \kappa_i(\tau-1)\Delta K_i(\tau)/K_i(\tau-1) + R(\tau)$$

<u>where</u>: $\frac{\Delta M(\tau)}{M(\tau-1)}$ is the rate of growth of national income in year τ.

$\lambda_i(\tau-1) \equiv \frac{P_{L_i}(\tau-1)L_i(\tau-1)}{M(\tau-1)}$ is the share of labour employed in Sector i in the national income of year $\tau-1$.

$\frac{\Delta L_i(\tau)}{L_i(\tau-1)}$ is the rate of growth of labour employment (man-hours) in Sector i in year τ.

$\kappa_i(\tau-1) \equiv \frac{Y_{K_i}(\tau-1)}{M(\tau-1)}$ is the share of capital employed in Sector i in the national income of year $\tau-1$.

$Y_{K_i}(\tau-1)$ is total income derived from capital employed in Sector i in year $\tau-1$.[1.]

$\frac{\Delta K_i(\tau)}{K_i(\tau-1)}$ is the rate of growth of capital employment in Sector i in year τ.

$R(\tau)$ is the percentage rate of growth of national income which is unexplained by changes in labour and capital input.

Hence, the percentage rate of growth of national income is a weighted average of the rates of growth of sectoral labour and capital employments, plus an unexplained residual. The residual captures the contribution of increases in total factor productivity.[2.]

The contribution of capital accumulation to growth is revealed in (5-1-1). Suppose, for instance, that $\Delta L_i(\tau) = R(\tau) = 0$. Then (5-1-1) can be written:

$$(5\text{-}1\text{-}2) \qquad \frac{\Delta M(\tau)}{M(\tau-1)} = \sum_i r_i^g (s\hat{\alpha}_i - \phi_{D_i})$$

<u>where</u>: s is the savings (equals investment) ratio; i.e., it is the share of national income devoted to savings.

r_i^g is the rate of return on Sector i capital, gross of taxes.

$\hat{\alpha}_i$ is gross investment in Sector i as a percentage of total gross investment. $(\sum_i \hat{\alpha}_i = 1)$

ϕ_{D_i} is the value of depreciation in Sector i as a percentage of national income.

It is clear from (5-1-2) that (ceteris paribus) the rate of growth of national income can be increased by devoting a larger share of gross investment to a sector with a higher gross rate of return. For growth, it is not necessary that aggregate net investment exceeds zero; i.e., it is not necessary that the aggregate stock of capital increases. To see this, an aggregate net investment of zero implies

$$\sum_i s\hat{\alpha}_i = \sum_i \phi_{D_i} .$$

Then,

$$\text{(5-1-3)} \qquad \sum_i r_i^g (s\hat{\alpha}_i - \phi_{D_i}) \neq 0 \text{ if } r_i^g \neq r_j^g \text{ for at least one pair of } i,j.$$

(5-1-3) indicates that if gross rates of return differ among sectors, a re-allocation of capital among sectors can increase output even if there is no change in the total stock of capital. This is the result emphasised in Chapters 3 and 4. The change in output observed between one long-run equilibrium path and another is referred to as intermediate-run growth. In the model of Chapters 3 and 4, adjustments were assumed to be instantaneous. In this case there is an infinite rate of intermediate-run growth following a disturbance, but this growth lasts only for an instant. In general, however, adjustments are not instantaneous. In this (latter) case, a disturbance is associated with a whole time path of intermediate-run adjustments. One source of such growth is related to improvements in resource allocation. This Section develops a model of intermediate-run adjustments to explore the relationship between tax policy disturbances and intermediate-run growth.

The analysis examines the rate of change of national income, M, during any discrete time period $\tau_k (k=1,\ldots,n)$, associated with a set of non-neutral tax disturbances dT_{K_i} (i=1,2,3), occurring at the beginning of period τ_1. All adjustments occur by the end of period τ_n. The total change in national income, after all adjustments have occurred, is the aggregate welfare loss:

$$(5\text{-}1\text{-}4) \qquad -\Delta W = dM = \sum_{k=1}^{n} \mathring{M}(\tau_k)$$

<u>where</u>: $\mathring{M}(\tau_k)$ is the time rate of change of M during period τ_k.

The percentage rate of change of national income (rate of growth) in period τ_k is

$$(5\text{-}1\text{-}5) \qquad m(\tau_k) = \mathring{M}(\tau_k)/M(\tau_{k-1})$$

<u>where</u>: $M(\tau_{k-1})$ is understood to be national income at the end of period τ_{k-1}.

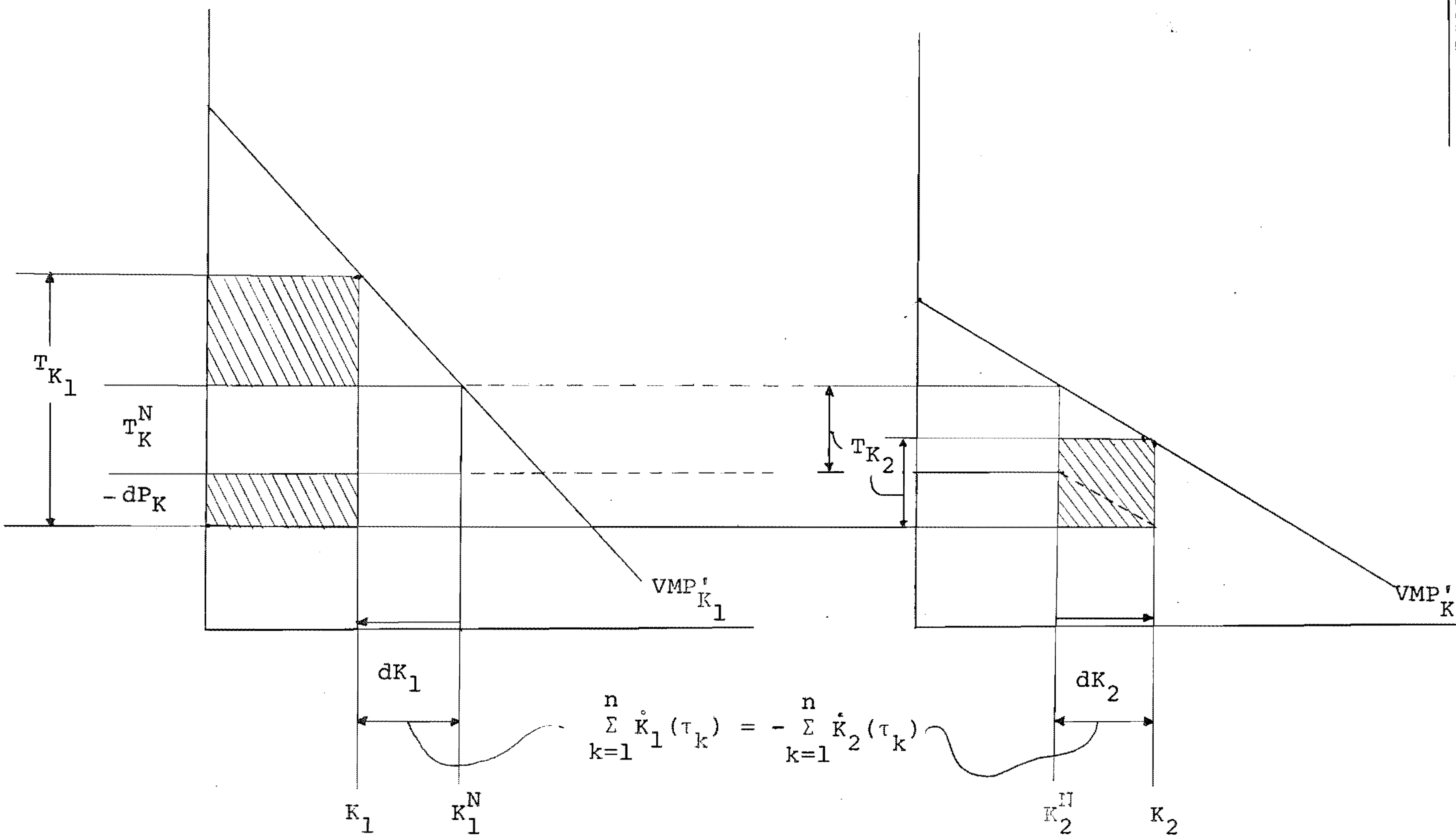
In Chapter 3 it was shown that

$$(5\text{-}1\text{-}6) \qquad dM = \sum_{i=1}^{3} d\{(P_{K_i}+\hat{\theta}_i q_i)K_i\} + \sum_{i=1}^{3} d(T_{K_i}K_i) + \sum_{i=1}^{3} d(P_{L_i}L_i).$$

Suppose, initially,[3.] that the non-neutral tax disturbance is a tax change dT_{K_i}, with tax rates on capital in the other two sectors ($j \neq i$) remaining at the pre-disturbance neutral tax rate. It is assumed throughout the analysis which follows that price adjustments are instantaneous (i.e., they occur at the beginning of period τ_1) but that quantity adjustments are sluggish (i.e., there are quantity lags only). The assumption on price adjustments is unrealistic; a more general analysis would permit lagged adjustment of both quantities and prices. The convenience of the assumption on price adjustments is that it implies a unique post-disturbance set of commodity and factor prices. In addition, the separation of price and quantity adjustments permits easy examination of "real" changes in output, which is the object of the present analysis.

Figure 5-1-1 illustrates the impact of a non-neutral tax disturbance of the sort considered here. In particular, Figure 5-1-1 supposes that there are only two sectors,[4.] that each sector is initially taxed at the rate T_K^N, and that the non-neutral tax disturbance is an increase, $dT_{K_1} = T_{K_1} - T_K^N$, in the tax rate on Sector 1.

FIGURE 5-1-1:



T_{K_1}
T_K^N
$-dP_K$
T_{K_2}
VMP'_{K_1}
VMP'_{K_2}
dK_1
dK_2
$\sum_{k=1}^{n} \dot{K}_1(\tau_k) = -\sum_{k=1}^{n} \dot{K}_2(\tau_k)$
K_1
K_1^N
K_2^N
K_2

As Figure 5-1-1 illustrates, following a non-neutral tax disturbance dT_{K_i}, the change in the net income of capital in that Sector i is

$$(5\text{-}1\text{-}7)\quad d\{(P_{K_i}+\hat{\Theta}_i q_i)K_i\}\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} = (P_{K_i}+\hat{\Theta}_i q_i)dK_i\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} + K_i^N dP_{K_i}\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}}$$

Since price adjustments are assumed instantaneous, (5-1-7) can be written

$$(5\text{-}1\text{-}8)\quad d\{(P_{K_i}+\hat{\Theta}_i q_i)K_i\}\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} = K_i^N dP_{K_i}\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} + (P_{K_i}+\hat{\Theta}_i q_i)\sum_{k=1}^{n}\mathring{K}_{i,i}(\tau_k)$$

<u>where</u>: $\displaystyle\sum_{k=1}^{n}\mathring{K}_{i,i}(\tau_k) = dK_i\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} = \frac{\partial K_i}{\partial T_{K_i}}.dT_{K_i}$ (i=1,2,3),

and in general:

$$\sum_{k=1}^{n}\mathring{K}_{i,j}(\tau_k) = \frac{\partial K_i}{\partial T_{K_j}}.dT_{K_j} \quad (i,j=1,2,3).$$

In addition to the changes summarized in (5-1-7) and (5-1-8), the tax disturbance dT_{K_i} induces a set of changes in net capital incomes in other sectors:

$$(5\text{-}1\text{-}9)\quad d\{(P_{K_j}+\hat{\Theta}_j q_j)K_j\}\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} = K_j^N dP_{K_j}\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} + (P_{K_j}+\hat{\Theta}_j q_j)\sum_{k=1}^{n}\mathring{K}_{j,i}(\tau_k),$$

$$j\neq i.$$

The total change (i.e., across all sectors) in net capital income following a tax disturbance $dT_{K_i} > 0$ ($dT_{K_j} = 0$, $j\neq i$) is, from (5-1-8) and (5-1-9):

$$(5\text{-}1\text{-}10)\quad d\{(P_{K_i}+\hat{\theta}_i q_i)K_i\}\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} + \sum_{j\neq i} d\{(P_{K_j}+\hat{\theta}_j q_j)K_j\}\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}}$$

$$= dP_K\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} \cdot \sum_{i=1}^{3} K_i + \frac{\partial K_i}{\partial T_{K_i}}.dT_{K_i} + \sum_{j\neq i}\frac{\partial K_j}{\partial T_{K_i}}.dT_{K_i}$$

$$= dP_K\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} \cdot \sum_{i=1}^{3} K_i\ ,$$

on using the condition that $dP_{K_i} = dP_K$ $(i=1,2,3)$, the normalization that $(P_{K_i} + \hat{\theta}_i q_i) = 1$ $(i=1,2,3)$, and equation (3-3-43), which derives from the assumption of fixed factor supplies.

Figure 5-1-2 illustrates the adjustment paths of $(P_{K_i} + \hat{\theta}_i q_i)K_i$ and $\sum_{j\neq i}(P_{K_j} + \hat{\theta}_j q_j)K_j$, in the special case of a linear lag operator on K_i, K_j, extending three periods (i.e., $n = 3$). Given that the stock of capital is in fixed total supply the rate at which the net income of capital falls in Sector i is identical to the (negative of the) sum of the rates of change of net capital income in Sectors $j\neq i$.

In the case of a whole set of tax disturbances $dT_{K_i}\neq 0$ $(i=1,2,3)$ the change in aggregate net capital income is, more generally:

$$(5\text{-}1\text{-}11)\qquad d\{(P_{K_i}+\hat{\theta}_i q_i)K_i\}+\sum_{j\neq i} d\{(P_{K_j}+\hat{\theta}_j q_j)K_j\}$$

$$= dP_K\cdot\sum_{i=1}^{3} K_i + \sum_{j=1}^{3}\frac{\partial K_i}{\partial T_{K_j}}.dT_{K_j} + \sum_{j\neq i}\sum_{i=1}^{3}\frac{\partial K_j}{\partial T_{K_i}}.dT_{K_i}$$

$$= dP_K\cdot\sum_{i=1}^{3} K_i + \sum_{i=1}^{3}\sum_{j=1}^{3}\frac{\partial K_i}{\partial T_{K_j}}.dT_{K_j}$$

$$= dP_K\cdot\sum_{i=1}^{3} K_i \quad .$$

In general, the assumption of instantaneous price adjustments implies no change in the aggregate net income of capital during periods τ_1 to τ_n. There is, however, a continual redistribution of net income among sectors during this time period.

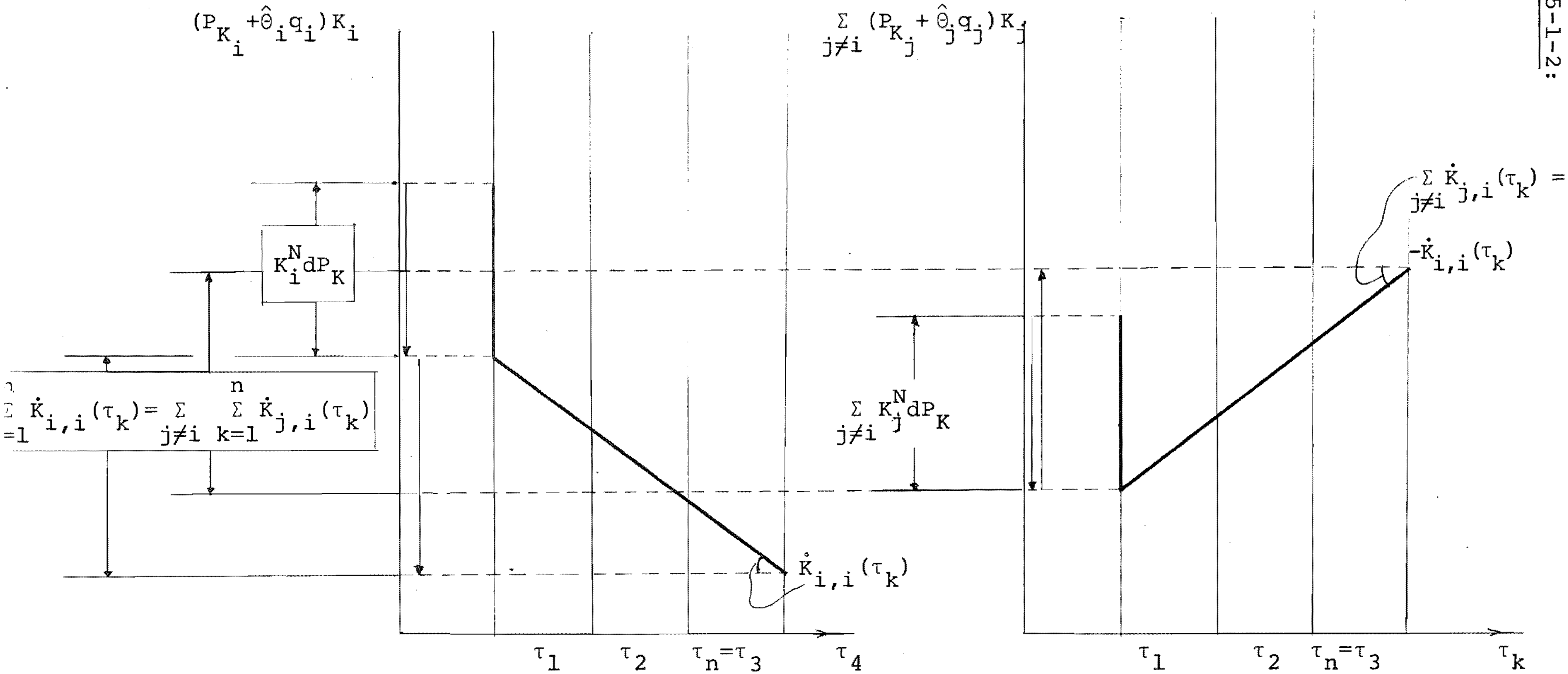
The effect of a tax disturbance dT_{K_i} on tax revenue derived from Sector i capital is

$$(5\text{-}1\text{-}12)\qquad d(T_{K_i}K_i)\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} = K_i^N.dT_{K_i}+T_{K_i}.dK_i\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}}$$

$$= K_i^N.dT_{K_i}+T_{K_i}.\sum_{k=1}^{n}\mathring{K}_{i,i}(\tau_k)$$

In addition, the change in tax revenue derived from capital in Sectors $j\neq i$ is:

$$(5\text{-}1\text{-}13)\qquad d(T_{K_j}K_j)\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} = T_{K_j}.dK_j\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} = T_{K_j}\sum_{k=1}^{n}\mathring{K}_{j,i}(\tau_k),\ j\neq i.$$



$(P_{K_i}+\hat{\theta}_i q_i)K_i$
$\sum_{j\neq i}(P_{K_j}+\hat{\theta}_j q_j)K_j$
$K_i^N dP_K$
$\sum_{k=1}^{n}\dot{K}_{i,i}(\tau_k)=\sum_{j\neq i}\sum_{k=1}^{n}\dot{K}_{j,i}(\tau_k)$
$\sum_{j\neq i}K_j^N dP_K$
$\mathring{K}_{i,i}(\tau_k)$
$\sum_{j\neq i}\dot{K}_{j,i}(\tau_k) = -\dot{K}_{i,i}(\tau_k)$
τ_1 τ_2 $\tau_n=\tau_3$ τ_4
τ_1 τ_2 $\tau_n=\tau_3$ τ_k

FIGURE 5-1-2:

The total change in tax revenue following a tax disturbance $dT_{K_i} > 0$ $(dT_{K_j} = 0,\ j \neq i)$ is, from (5-1-12) and (5-1-13)

$$(5\text{-}1\text{-}14)\qquad d(T_{K_i}K_i)\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} + \sum_{j\neq i} d(T_{K_j}K_j)\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}}$$

$$= K_i^N dT_{K_i} + T_{K_i}\sum_{k=1}^{n}\mathring{K}_{i,i}(\tau_k) + \sum_{j\neq i} T_{K_j}\sum_{k=1}^{n}\mathring{K}_{j,i}(\tau_k)$$

The time rate of change of tax revenue is, from (5-1-14),

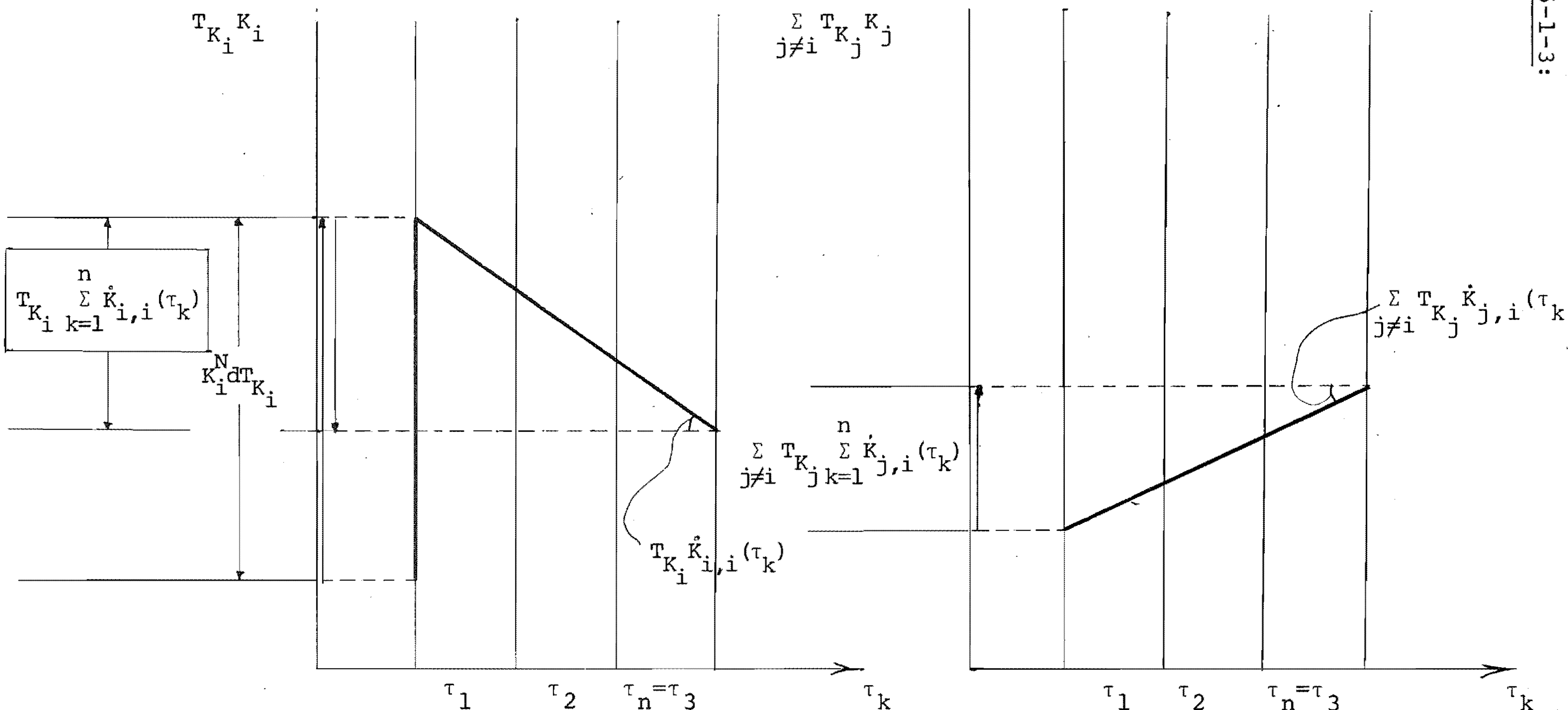
$$(5\text{-}1\text{-}15)\qquad \mathring{\bar{T}}_K(\tau_k)\Big|_{\substack{dT_{K_j}=0\\(j\neq i)}} = T_{K_i}\mathring{K}_{i,i}(\tau_k) + \sum_{j\neq i} T_{K_j}\mathring{K}_{j,i}(\tau_k).$$

The fixity of factor supplies implies

$$(5\text{-}1\text{-}16)\qquad \mathring{K}_{i,i}(\tau_k) + \sum_{j\neq i}\mathring{K}_{j,i}(\tau_k) = 0,$$

but it is clear that the time rate of change of tax revenue from capital is non-zero (in fact, strictly negative in this case) because of differences in unit tax rates, $T_{K_i} \neq T_{K_j}$.

Figure 5-1-3 illustrates the adjustment paths of $T_{K_i}K_i$ and $\sum_{j\neq i} T_{K_j}K_j$, assuming a linear lag operator on K_i, K_j, extending three periods. At the beginning of period τ_1, the tax revenue from capital in Sector i increases by $K_i^N dT_{K_i}$. (i.e., capital in Sector i bears the full burden of the tax, initially.) Over time, some of the burden of the tax is shifted onto capital in other sectors, as capital moves from Sector i to Sectors $j \neq i$.



$T_{K_i}K_i$
$T_{K_i}\sum_{k=1}^{n}\dot{K}_{i,i}(\tau_k)$
$K_i^N dT_{K_i}$
$T_{K_i}\dot{K}_{i,i}(\tau_k)$
τ_1
τ_2
$\tau_n=\tau_3$
τ_k
$\sum_{j\neq i}T_{K_j}K_j$
$\sum_{j\neq i}T_{K_j}\dot{K}_{j,i}(\tau_k)$
$\sum_{j\neq i}T_{K_j}\sum_{k=1}^{n}\dot{K}_{j,i}(\tau_k)$
τ_1
τ_2
$\tau_n=\tau_3$
τ_k

FIGURE 5-1-3:

In the case of a whole set of tax disturbances $dT_{K_i} \neq 0$ $(i=1,2,3)$ the change in total tax revenue from capital is

$$(5\text{-}1\text{-}17) \qquad d(T_{K_i}K_i) + \sum_{j\neq i} d(T_{K_j}K_j)$$

$$= \sum_{i=1}^{3} K_i^N dT_{K_i} + T_{K_i} \sum_{j=1}^{3} \sum_{k=1}^{n} \mathring{K}_{i,j}(\tau_k) + \sum_{j\neq i} T_{K_j} \sum_{i=1}^{3} \sum_{k=1}^{n} \mathring{K}_{j,i}(\tau_k)$$

$$= \sum_{i=1}^{3} K_i^N dT_{K_i} + \sum_{i=1}^{3} T_{K_i} \sum_{j=1}^{3} \sum_{k=1}^{n} \check{K}_{i,j}(\tau_k)$$

The time rate of change of tax revenue from capital is

$$(5\text{-}1\text{-}18) \qquad \mathring{\bar{T}}_K(\tau_k) = \sum_{i=1}^{3} T_{K_i} \sum_{j=1}^{3} \check{K}_{i,j}(\tau_k)$$ [5].

Again, this is generally non-zero.

Recalling Figure 5-1-1, a non-neutral tax disturbance dT_{K_i} causes a change in labour income in Sector i of (this measure is a rough approximation only)

$$(5\text{-}1\text{-}19) \qquad d(P_{L_i}L_i)\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} = -K_i\left(dT_{K_i} + dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}}\right)$$

$$+ \tfrac{1}{2} dK_i\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} \left(dT_{K_i} + dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}}\right)$$

$$= -K_i\left(dT_{K_i} + dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}}\right)$$

$$+ \tfrac{1}{2}\left(dT_{K_i} + dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq 1)}}\right) \sum_{k=1}^{n} \mathring{K}_{i,i}(\tau_k)$$

The associated change in labour income in Sectors $j \neq i$ is (approximately)

$$(5\text{-}1\text{-}20)\quad d(P_{L_j} L_j)\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} = -K_j^N . dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} -\tfrac{1}{2} . dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} . dK_j\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}}$$

$$= -K_j^N . dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} -\tfrac{1}{2}\, dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} . \sum_{k=1}^{n} \mathring{K}_{j,i}(\tau_k)$$

The total change in labour income following a tax disturbance $dT_{K_i} > 0, dT_{K_j} = 0$, $j\neq i$) is, from (5-1-19) and (5-1-20),

$$(5\text{-}1\text{-}21)\quad d(P_{L_i} L_i)\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} + \sum_{j\neq i} d(P_{L_j} L_j)\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}}$$

$$= -\sum_{i=1}^{3} K_i^N . dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} -K_i^N dT_{K_i} -\tfrac{1}{2} dT_{K_i} \sum_{k=1}^{n} \mathring{K}_{i,i}(\tau_k)$$

$$-\tfrac{1}{2} . dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} \left(\sum_{j=1}^{3} \sum_{k=1}^{n} \mathring{K}_{j,i}(\tau_k)\right)$$

$$= -\sum_{i=1}^{3} K_i^N . dP_K\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} -K_i^N dT_{K_i} -\tfrac{1}{2} dT_{K_i} \sum_{k=1}^{n} \mathring{K}_{i,i}(\tau_k)$$

The time rate of change of labour income is

$$(5\text{-}1\text{-}22)\quad P_{L_i} \dot{L}_i(\tau_k)\Big|_{\substack{dT_{K_j}=0 \\ (j\neq i)}} = -\tfrac{1}{2} dT_{K_i} \dot{K}_{i,i}(\tau_k)$$

Figure 5-1-4 illustrates the dynamic adjustments in labour income. The initial impact of the tax disturbance $dT_{K_i} > 0$ is to increase labour income in Sectors $j \neq i$ by $-\sum_{j \neq i} K_i^N dP_K$. Over time, labour income in Sector i falls as labour income in Sectors $j \neq i$ increases.

The change in labour income resulting from a whole set of tax disturbances $dT_{K_i} \neq 0$ (i=1,2,3) is

$$(5\text{-}1\text{-}23) \qquad d\sum_{i=1}^{3} P_{L_i} L_i = -dP_K \sum_{i=1}^{3} K_i^N - \sum_{i=1}^{3} K_i^N dT_{K_i}$$

$$-\tfrac{1}{2}\sum_{i=1}^{3} dT_{K_i} \sum_{j=1}^{3} \sum_{k=1}^{n} \mathring{K}_{i,j}(\tau_k)$$

$$= -dP_K \sum_{i=1}^{3} K_i^N - \sum_{i=1}^{3} K_i^N dT_{K_i} - \tfrac{1}{2}\sum_{i=1}^{3} T_{K_i} \sum_{j=1}^{3} \sum_{k=1}^{n} \mathring{K}_{i,j}(\tau_k)$$

The time rate of change of aggregate labour income is

$$(5\text{-}1\text{-}24) \qquad P_{L_i} \dot{L}_i(\tau_k) = -\tfrac{1}{2}\sum_{i=1}^{3} T_{K_i} \sum_{j=1}^{3} \mathring{K}_{i,j}(\tau_k)$$

which is generally non-zero.

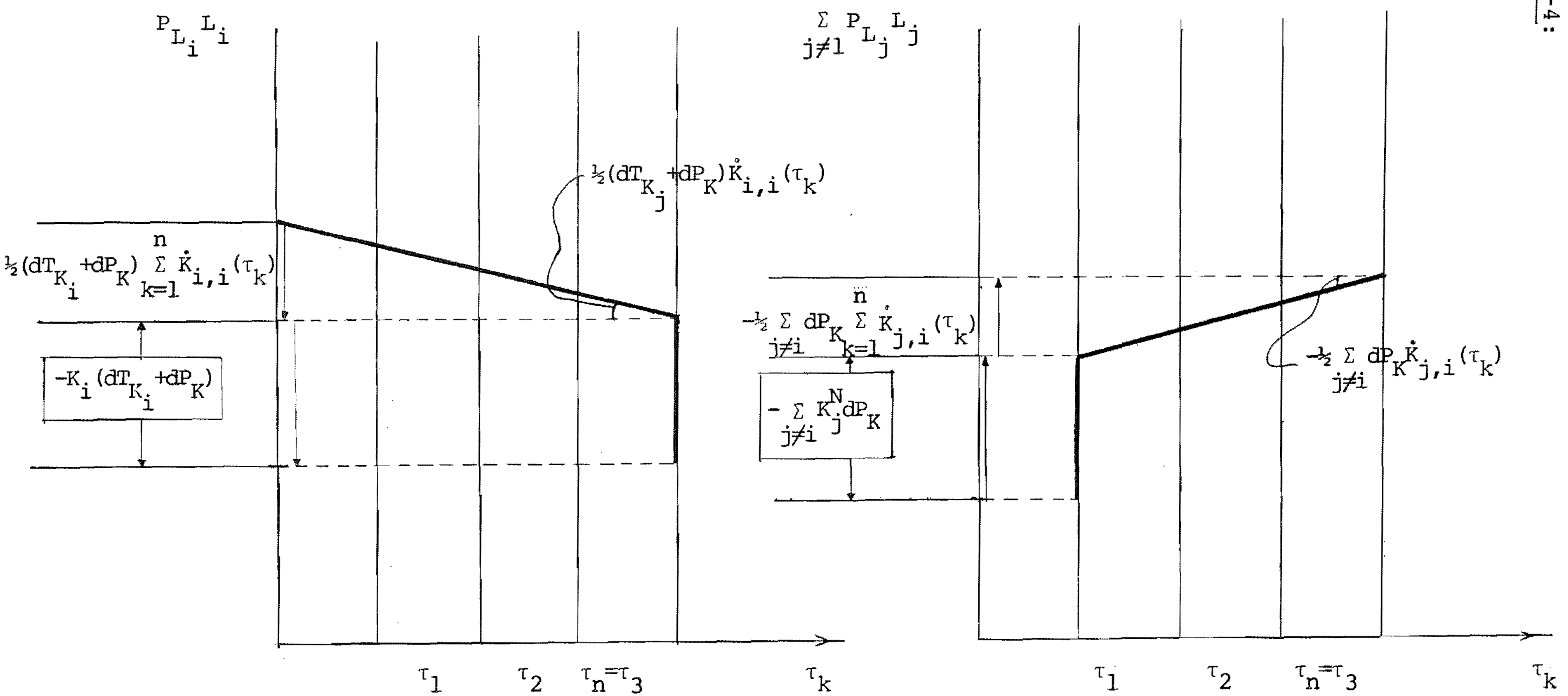
On combining (5-1-18) and (5-1-24), the time rate of change of national income is

$$(5\text{-}1\text{-}25) \qquad \mathring{M}(\tau_k) = \tfrac{1}{2}\sum_{i=1}^{3} T_{K_i} \sum_{j=1}^{3} \mathring{K}_{i,j}(\tau_k)$$

$$= \tfrac{1}{2}\sum_{i=1}^{3} T_{K_i} \mathring{K}_i(\tau_k)$$

<u>where</u>: $\mathring{K}_i(\tau_k) = \sum_{j=1}^{3} \mathring{K}_{i,j}(\tau_k)$ is the time rate of change of capital in Sector i (in period τ_k) following a set of tax changes $dT_{K_j} \neq 0$ (j=1,2,3).

FIGURE 5-1-4:



P L_i L_i
½(dT K_j +dP K) K̊ i,i (τ k)
½(dT K_i +dP K) Σ k=1 n K̇ i,i (τ k)
-K_i (dT K_i +dP K)
τ 1
τ 2
τ n=τ 3
τ k
Σ j≠1 P L_j L_j
-½ Σ j≠i dP K Σ k=1 n K̇ j,i (τ k)
- Σ j≠i K_j^N dP K
-½ Σ j≠i dP K K̇ j,i (τ k)
τ 1
τ 2
τ n=τ 3
τ k

The particular way in which the $K_i(\tau_k)$ are related to the dK_i depends upon the particular lag pattern assumed. The flexible accelerator model of investment, originated by Chenery (1952) and Koyck (1954), proposes that changes in desired (optimal) capital stocks are transformed into actual changes by a geometric distributed lag function.[6.] In particular, suppose that actual capital stocks in Sector i may be expressed as a weighted average of all past optimal capital stocks in that sector:

$$(5\text{-}1\text{-}26) \qquad K_i(\tau_k) = (1-\lambda_i)\sum_{\ell=0}^{\infty}\lambda_i^{\ell}K_i^*(\tau_{k-\ell}) \quad , \qquad \lambda_i \in (0,1)$$

where: $K_i^*(\tau_{k-\ell})$ is the optimal stock of Sector i capital at the end of period $\tau_{k-\ell}$.

$K_i(\tau_k)$ is the actual stock of Sector i capital at the end of period τ_k.

The particular form of the flexible accelerator in (5-1-26) is often referred to as a distributed lag function. It is widely used in econometric analyses of investment behaviour.[7.]

(5-1-26) reveals:

$$(5\text{-}1\text{-}27) \qquad \mathring{K}_i(\tau_k) = (1-\lambda_i)\sum_{\ell=0}^{\infty}\lambda_i^{\ell}\mathring{K}^*(\tau_{k-\ell})$$

$$= (1-\lambda_i)\sum_{\ell=0}^{\infty}\lambda_i^{\ell}dK_i(\tau_{k-\ell})^{8.}, \qquad \lambda \in (0,1).$$

Hence, if there is a unique change in optimal capital stocks $dK_i(\tau_s)$ (i=1,2,3), (5-1-27) can be written:

$$(5\text{-}1\text{-}28) \qquad \dot{K}_i(\tau_k) = (1-\lambda_i)\lambda_i^{(k-s)} dK_i(\tau_s),$$

with the restriction that

$$(5\text{-}1\text{-}29) \qquad \sum_{k=s}^{\infty} \mathring{K}_i(\tau_k) = dK_i(\tau_s)^{9}.$$

(5-1-28) and (5-1-29) imply:

$$(5\text{-}1\text{-}30) \qquad \sum_{k=s}^{\infty} (1-\lambda_i)\lambda_i^{(k-s)} = 1.$$

(5-1-28) in (5-1-25) reveals:

$$(5\text{-}1\text{-}31) \qquad \mathring{M}(\tau_k) = \tfrac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda_i)\lambda_i^{(k-s)} dK_i(\tau_s)$$

Hence, the time rate of change of national income during any arbitrary period τ_k depends upon the change in the optimal allocation of capital in some previous period τ_s, due to a set of tax disturbances occurring at the beginning of period τ_s, and upon the shapes of the distributed lag functions relating changes in optimal capital stocks to changes in actual stocks, in each sector.

The requirement that the total stock of capital be in fixed supply at all times restricts the diversity of lag distributions in the economy. Hence, since

$$\sum_{i=1}^{3} \mathring{K}_i(\tau_k) = 0 = \sum_{i=1}^{3} dK_i(\tau_s) \;,$$

(5-1-28) reveals that $(1-\lambda_i)\lambda_i^{(k-s)}$ has the same value for all i. Denote this value by $(1-\lambda)\lambda^{(k-s)}$.

(5-1-31) can be used to show the rate of increase in national income due to improvements in resource allocation. Hence, suppose the government initiates a neutral tax policy at the beginning of period τ_s. The increase in national income following this policy initiative, in any period τ_k, is simply the negative of the right-hand-side of (5-1-31).

5.2 SIMULATED DYNAMIC ADJUSTMENTS TO CHANGES IN TAX POLICY.

This section extends the analysis of Section 5.1 by presenting some simulations of potential growth rates following a tax policy disturbance. In particular the simulations are performed for a neutral tax policy disturbance, which equalises tax rates among sectors. Simulations are performed for Australia only, although similar calculations can be performed for each of the other countries considered in Chapter 4.

The equations of change derived in Section 5.1 describe the consequences of the imposition of a set of non-neutral tax disturbances on an initial neutral tax system. The simulations presented in this section are concerned with the imposition of a neutral tax policy on an initial non-neutral tax system. This requires reversing the sign on each of the equations of change presented in Section 5.1. Table 5-2-1 presents the equations of change for the first five years following a neutral tax policy disturbance. In that table, the T_{K_i} are tax rates under present law; dP_K is the change in the net rental price of capital due to the present non-neutral tax system; the dK_i are the distortions in capital allocation due to the

TABLE 5-2-1: Equations of Change Describing the Time Profile of Adjustments to Neutral Tax Policy.[1]

Year	Change in National Income Components During Year.			
	Labour[2]	Capital[3]	Taxes on Capital[4]	Total[5]
τ_1	$dP_K \sum_{i=1}^{3} K_i^N$ $+ \sum_{i=1}^{3} K_i^N dT_{K_i}$ $+\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda) dK_i$	$-dP_K \sum_{i=1}^{3} K_i^N$	$- \sum_{i=1}^{3} K_i^N dT_{K_i}$ $- \sum_{i=1}^{3} T_{K_i} (1-\lambda) dK_i$	$-\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda) dK_i$
τ_2	$\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda dK_i$	0	$- \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda dK_i$	$-\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda dK_i$
τ_3	$\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^2 dK_i$	0	$- \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^2 dK_i$	$-\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^2 dK_i$
τ_4	$\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^3 dK_i$	0	$- \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^3 dK_i$	$-\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^3 dK_i$
τ_5	$\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^4 dK_i$	0	$- \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^4 dK_i$	$-\frac{1}{2} \sum_{i=1}^{3} T_{K_i} (1-\lambda)\lambda^4 dK_i$

Notes:

1. Tax policy is initiated at beginning of Year τ_1.
2. The equation of change is obtained by using (5-1-28) in (5-1-23), (5-1-24), and changing sign.
3. The equation of change is obtained by using (5-1-28) in (5-1-11), and changing sign.
4. The equation of change is obtained by using (5-1-28) in (5-1-17), (5-1-18), and changing sign.
5. The equation of change is obtained by using (5-1-28) in (5-1-25), and changing sign.

TABLE 5-2-2: Illustrative Calculations of the Time Profile of Adjustments to Neutral Tax Policy; Different Geometric Lag Distribution; Australia.

Year[1.]	Potential Additional Change in National Income Components														
	λ = .25					λ = .5					λ = .75				
	Labour	Capital	Capital Taxes	Total		Labour	Capital	Capital Taxes	Total		Labour	Capital	Capital Taxes	Total	
	($ Million)			($m.)	%[2.]	($ Million)			($m.)	%[2.]	($ Million)			($m.)	%[2.]
1978	-417.06	570.57	-61.40	92.11	.11	-386.36	570.57	-122.80	61.41	.07	-355.66	570.57	-184.20	30.71	.04
1979	-23.03	0	46.06	23.03	.03	-30.70	0	61.40	30.70	.04	-23.03	0	46.06	23.03	.03
1980	-5.76	0	11.52	5.76	.0	-15.35	0	30.70	15.35	.02	-17.27	0	34.54	17.27	.02
1981	-1.44	0	2.88	1.44	.0	-7.68	0	15.36	7.68	.01	-12.95	0	25.90	12.95	.01
1982	-0.36	0	.72	.36	.0	-3.84	0	7.68	3.84	.0	-9.71	0	19.42	9.71	.01
TOTALS	-447.65	570.57	-.22	122.70		-443.93	570.57	-7.66	118.98		-418.62	570.57	-58.28	93.67	

Notes: 1. Fiscal year ending 30th June in calendar year shown.

2. The figure is the change in national income during the year as a percentage of national income at the beginning of the year.

present non-neutral tax system; and the dT_{K_i} are taxes under present law less taxes under neutrality.

Table 5-2-2 presents illustrative calculations of the time profile of adjustments to an equal-yield neutral tax policy in Australia. The tax policy is initiated on 1st July 1977, the beginning of the 1977-78 fiscal year. Three different geometric lag distributions are explored. The closer is λ to unity, the slower is the process of adjustment. The neutral tax policy produces an increase in national income of $122.80 million annually once all adjustments have taken place. If λ = .25, national income increases by $92.11 million in the first year following the tax disturbance. In the second year, national income increases by a further $23.03 million. Hence, national income in the second year is $115.14 million (=$92.11m.+ $23.03m.) larger than it would have been in the absence of the tax disturbance. National income in the fifth year (the 1981-82 fiscal year) is $122.70 million larger than it would have been. Over the five years the total flow of national income is $573.19 million larger than it would have been in the absence of the tax policy disturbance.

If λ = .5, national income in the fiscal year 1981-82 is $118.98 million larger than it would have been if the tax policy disturbance had not been initiated at the beginning of the 1977-78 fiscal year. Once all adjustments have occurred, national income is $122.8 million larger. Hence, in some sense, approximately 96.89 percent

percent (=118.98 ÷ 122.8) of adjustments take place by the end of the fifth year. If λ = .25, the figure is 99.92 percent, and if λ = .75, the figure is 76.28 percent.

Table 5-2-2 also presents the growth rates in national income in each year following an equal-yield neutral tax policy disturbance. The figure is the change in national income during the year as a percentage of national income at the beginning of the year. The figures are quite small, which is not very surprising. The figures should not be taken as the maximum potential rates of growth that would be stimulated by an equal-yield neutral tax policy disturbance. One reason for this is that the simulations assume a constant total stock of capital over the five years. More realistically, improvements in resource allocation due to the tax disturbance increase national income, and so increase the flow of savings available to finance capital accumulation; the larger capital stock adds more to output growth in later periods.

This chapter has attempted to indicate the potential time rate of change of national income, over a specific number of periods, following a neutral tax policy disturbance. The power of the analysis is limited by its assumption that the total stock of capital is in fixed supply. The investigation of a similar question in the context of variable factor supplies is deserving of investigation.

Footnotes to Chapter Five

1. This is derived in Chapter 3: see equation (3-1-9).

2. Most studies of the sources of growth attribute most of the causation to changes in total factor productivity. Jorgenson and Griliches (1967, at p.249) challenge this finding with the hypothesis that "... if quantities of output and input are measured accurately, growth in total output is largely explained by growth in total input."

3. The more general case is developed below.

4. The third sector can be added, but only complicates matters.

5. Note that $\sum_{i=1}^{3} \dot{K}_{i,j}(\tau_k) = 0$, but in general

   $\sum_{j=1}^{3} \dot{K}_{i,j}(\tau_k) \neq 0.$

6. This proposition is one of the least contentions of all issues in the investment literature. Jorgenson (1971) emphasises this point.

7. See Jorgenson (1971) for references.

8. The assumption of a fixed total stock of capital implies gross investment sufficient to off-set depreciation only.

9. i.e., $n = \infty$.

CHAPTER SIX

HOUSING POLICY IN THE LONG-RUN

Chapter 5 considered the time-path of intermediate-run adjustments to the removal of the owner-occupier subsidy. This is not the only dynamic issue of interest in an analysis of housing policy. This chapter presents a preliminary examination of some of the long-run implications of the favourable tax treatment of owner-occupied housing. Section 6.1 explores the dynamic incidence of the owner-occupier subsidy in a modified neoclassical growth model. Section 6.2 extends the analysis of Section 6.1 to a consideration of the optimal taxation of housing in the long-run.

6.1 THE DYNAMIC INCIDENCE OF THE OWNER-OCCUPIER SUBSIDY

The dynamic incidence of taxes on capital has been the subject of considerable recent interest. Diamond (1970) concludes that a reduction in capital taxes increases the per capita rewards of both capital and labour. Grierson (1975) examines the rate of capital taxation that will maximize wages, under a variety of assumptions about government expenditures. He emphasises that the rate of capital taxation which maximizes labour's total earnings depends upon labour's ownership of capital, and the consumption discount rate. Feldstein (1974), Krzyzaniak

(1967), and Sato (1967) are concerned with related problems. These analyses have all been in terms of two-factor growth models. To examine the incidence of the owner-occupier subsidy a third factor (residential, as distinct from non-residential, capital) is required.[1.]

Suppose that there are three factors of production. K_1 denotes the physical stock of residential capital; K_2 denotes the physical stock of non-residential capital; and L denotes the labour stock. Production is described by a linear homogeneous production function which is, in per capita terms:

(6-1-1) $$f(k_1,k_2)^{2.} \quad , \quad f_1,f_2 > 0,\ f_{11},f_{22} < 0.$$

<u>where</u>: $k_i \equiv K_i/L$ is the stock of type i capital, per worker.

f_i is the marginal physical product of type i capital.

All factor incomes are subject to taxation. The subsidy to housing implies a lower rate of income tax on the earnings of residential capital. The competitive market conditions are summarized by

(6-1-2) $$r_1 = (1-t_1)f_1$$

(6-1-3) $$r_2 = (1-t)f_2$$

(6-1-4) $$w = (1-t)\{f-f_1k_1-f_2k_2\}$$

<u>where</u>: r_i is the after-tax rate of return to capital of type i.

w is the after-tax real wage rate.

Total taxes are a proportion t^* of national income. i.e.,

(6-1-5) $$t^*f = t_1f_1k_1 + t_2f_2k_2 + t\{f-f_1k_1-f_2k_2\}$$
$$= t_1f_1k_1 + t(f-f_1k_1).$$

Grierson (1975) assumes that t^* is a constant. Here it is variable, but t is constant.[3.]

(6-1-5) implies

(6-1-6) $$t^* = t_1\Theta_{K_1} + t(1-\Theta_{K_1}) = t - (t-t_1)\Theta_{K_1}$$

<u>where</u>: Θ_{K_1} is the gross-of-tax share of capital in output.

$(t-t_1)$ is the rate of subsidy to housing.

Assuming that the Government balances its budget, per capita savings out of total income are

(6-1-7) $$sf(1-t^*) = sf\{(1-t_1) - (t-t_1)(1-\Theta_{K_1})\}$$

<u>where</u>: s is the private marginal propensity to save out of income.[4.]

The labour force grows exponentially according to

(6-1-8) $$L(\tau) = L_0e^{n\tau}$$

<u>where</u>: n is the growth rate.

The time rates of change of k_1 and k_2 are given by

(6-1-9) $$\dot{k}_i = \frac{\mathring{K}_i}{L} - nk_i , \qquad i=1,2.$$

With no depreciation,

(6-1-10) $$\frac{\mathring{K}_i}{L} = g_i \qquad i=1,2$$

where: g_i is gross investment in capital of type i, per worker.

Macroeconomic equilibrium requires

(6-1-11) $$g_1 + g_2 = sf(1-t^*)$$

A long-run balanced growth path is characterised by

(6-1-12) $$\mathring{k}_1 = \mathring{k}_2 = 0.$$

This implies, on using (6-1-9), (6-1-10), (6-1-11),

(6-1-13) $$n(k_1+k_2) = sf(1-t^*) = sf\{(1-t)+(t-t_1)\Theta_{K_1}\}$$

The incidence of the owner-occupier subsidy is investigated by varying t_1, and observing the effect on r_1, r_2, and w. From (6-1-13)

(6-1-14) $$n\left(\frac{dk_1}{dt_1} + \frac{dk_2}{dt_1}\right) = (1-t^*)s\left(f_1\frac{dk_1}{dt_1} + f_2\frac{dk_2}{dt_1}\right) - sf\Theta_{K_1} - sft_1\frac{d\Theta_{K_1}}{dt_1}$$

since t,s, are constants. dk_i/dt_1 is the change in the long-run equilibrium value of k_i due to a tax change dt_1. $d\Theta_{K_1}/dt_1$ can be evaluated:

(6-1-15) $$\Theta'_{K_1} \equiv \frac{d\Theta_{K_1}}{dt_1} = \frac{\{f_1\frac{dk_1}{dt_1}((1-\Theta_{K_1})\varepsilon_{11}+1) - \varepsilon_{11}\Theta_{K_1}f_2\frac{dk_2}{dt_1}\}}{\varepsilon_{11}{}^2}$$

where: $\varepsilon_{ij} = f_j/f_{ji}k_i$ is the (cross-price) elasticity of demand for type i capital with respect to the gross-of-tax price of type j capital.

In addition, it can be shown that

(6-1-16) $$\frac{dk_2}{dt_1} = \frac{\varepsilon_{21}}{\varepsilon_{11}} \cdot \frac{k_2}{k_1} \cdot \frac{dk_1}{dt_1}.$$

(6-1-16) in (6-1-15) produces

(6-1-17) $$\Theta'_{K_1} = \frac{dk_1}{dt_1} \; \frac{1}{k_1} \cdot \frac{\Theta_{K_1}}{\varepsilon_{11}} \{(1+\varepsilon_{11}) - (\varepsilon_{11}\Theta_{K_1} + \varepsilon_{21}\Theta_{K_2})\}$$

Now from (6-1-14), (6-1-16), (6-1-17)

(6-1-18) $$\frac{dk_1}{dt_1} = \frac{-\Theta_{K_1}\varepsilon_{11}k_1}{D_2}$$

(6-1-19) $$\frac{dk_2}{dt_1} = \frac{-\Theta_{K_1}\varepsilon_{21}k_2}{D_2}$$

where: $D_2 \equiv \{\varepsilon_{11}(\kappa_1 - \Theta_{K_1}) + \varepsilon_{21}(\kappa_2 - \Theta_{K_2})\}\{1 - t(1 - \Theta_{K_1})\}$

$+ t_1\Theta_{K_1}\{(1+\varepsilon_{11}) - (\varepsilon_{11}\kappa_1 + \varepsilon_{21}\kappa_2)\}$

$\kappa_i \equiv k_i/(k_1+k_2)$

In general, (6-1-18), (6-1-19) cannot be signed. However, it can be shown that local stability requires that[5].

(6-1-20) $$(\kappa_i - \Theta_{K_i}) > 0 \qquad , \qquad i=1,2,$$

and clearly,

(6-1-21) $$\{(1+\varepsilon_{11}) - (\varepsilon_{11}\kappa_1 + \varepsilon_{21}\kappa_2)\} \gtreqless 0 \text{ as } (1+\varepsilon_{11}) \gtreqless \varepsilon_{11}\kappa_1 + \varepsilon_{21}\kappa_2$$

To investigate the incidence of the subsidy to housing, observe that, from (6-1-2), (6-1-18)

$$(6\text{-}1\text{-}22) \qquad \frac{dr_1}{dt_1} = (1-t_1) f_{11} \frac{dk_1}{dt_1} - f_1$$

$$= \frac{-f_1\{D_2 + (1-t_1)\Theta_{K_1}\}}{D_2} .$$

Further, from (6-1-3), (6-1-19)

$$(6\text{-}1\text{-}23) \qquad \frac{dr_2}{dt_1} = (1-t) f_{22} \frac{dk_2}{dt_1}$$

$$= \frac{-(1-t) f_2 (\varepsilon_{21}/\varepsilon_{22}) \Theta_{K_1}}{D_2}$$

$$(6\text{-}1\text{-}24) \qquad \frac{dw}{dt_1} = -(1-t)\{(f_1/\varepsilon_{11})\frac{dk_1}{dt_1} + (f_2/\varepsilon_{22})\frac{dk_2}{dt_1}\}$$

$$= \frac{f(1-t)\Theta_{K_1}\{\Theta_{K_1} + (\varepsilon_{21}/\varepsilon_{22})\Theta_{K_2}\}}{D_2}$$

The incidence equations (6-1-18), (6-1-19), (6-1-22), (6-1-23), (6-1-24) cannot be signed unambiguously. The sign of each of these equations depends upon relative factor shares, and upon the degree of substitution among factors in production.[6.] It appears that the relatively simple incidence equations obtained in the usual one-sector models (Grierson (1975, pp.78-79), for instance) become quite complex when more than two factors are permitted. Equations (6-1-22) to (6-1-24) emphasise that this is so: In the present model there is no distinction between worker and capitalist savings rates, which is the principal source of interest in the two-factor incidence equations.

6.2 THE OPTIMAL TAXATION OF HOUSING CAPITAL IN THE LONG-RUN.

The static general equilibrium analysis of Chapters 3 and 4 emphasised the distortions created by policies which tax housing incomes favourably relative to income earned by capital in other uses. Optimal taxation has been interpreted as the tax system which maximizes national income. In a world of fixed factor endowments, it was shown that optimality requires equality of tax rates on sectoral capital incomes. There is an important reason why equality of tax rates might not be an "optimal" tax policy, in general, however. This is that maximisation of national income might not be an appropriate objective;[7.] in particular, this objective ignores the social arguments for housing, discussed in Chapter 1. This section explores optimal tax policies in long-run growth.[8.]

Aaron (1972) suggests that the social arguments for housing rest on allegations of positive externalities associated with quality housing.[9.] To capture the social importance of housing, suppose that the utility of the representative individual is represented by

(6-2-1) $$u = u(c,k_1),$$ [10.]

which is assumed concave with respect to both arguments. Economic planners maximize (6-2-1) subject to

(6-2-2) $$c = f\{1-s(1-t^*)\} = f\{1-s(1-t)-s(t-t_1)\Theta_{K_1}\},$$

and the balanced growth condition that

(6-2-3) $$sf(1-t^*) = n(k_1+k_2)$$

First-order necessary conditions include:

(6-2-4) $$f_1 = n - U_{k_1}/U_c$$

<u>where</u>: $U_{k_1} \equiv \partial u/\partial k_1$ is the marginal utility of housing.

$U_c \equiv \partial u/\partial c$ is the marginal utility of consumption.

(6-2-5) $$f_2 = n.$$

(6-2-4), (6-2-5) are the modified Phelps (1961)-Swan (1956)-Solow (1956) golden-rule of accumulation. Hence, (6-2-4), (6-2-5) in (6-2-3) imply the optimal rate of private saving:

(6-2-6) $$s(1-t^*) = \Theta_{K_1} + \Theta_{K_2} + (U_{k_1}/U_c)k_1/f$$

The term $(U_{k_1}/U_c)k_1$ is the utility value of k_1 units of housing, in terms of the consumption good. Given a private savings ratio, s, (6-2-6) implies a relationship between the optimal value of the tax rate, t*, and output. In particular,

$$(1-t^*) = \frac{\Theta_{K_1}+\Theta_{K_2}}{s} + \frac{\left(\frac{U_{k_1}}{U_c}\right)k_1}{sf}$$

which, on using (6-1-6) reveals,

(6-2-7) $$(t-t_1) = \frac{\Theta_{K_1}+\Theta_{K_2}}{s\Theta_{K_1}} + \frac{\left(\frac{U_{k_1}}{U_c}\right)k_1}{sf\Theta_{K_1}} - \frac{(1-t)}{\Theta_{K_1}}$$

$$= \frac{f(\Theta_{K_1}+\Theta_{K_2})+(U_{k_1}/U_c)k_1-sf(1-t)}{sf\Theta_{K_1}}$$

$$\gtreqless 0 \text{ as } f(\Theta_{k_1}+\Theta_{k_2}) + k_1(U_{k_1}/U_c) \gtreqless sf(1-t)$$

It is clear from (6-2-7) that, given a chosen value of t, the optimal size of the subsidy to housing increases with increases in the utility value of the stock of housing. When $U_{k_1} = 0$, housing is subsidized under optimal tax policy only if total capital income exceeds what would be saved if there were no subsidy to housing. The ambiguity of (6-2-7) provides scope for additional theoretical and empirical research.

Footnotes to Chapter Six.

1. Much of the literature on growth theory focuses on models with a single capital good: Solow (1956), for instance. Hahn (1966) appears to be the first serious attempt to generalise over the number of capital goods.

2. Shell and Stiglitz (1967) have investigated the dynamic properties of a one-sector growing economy with two capital goods. In particular, they question Hahn's (1966) findings that in an economy with heterogeneous capital goods, the growth path may be indeterminate, and not all paths of accumulation will converge to balanced growth. Shell and Stiglitz find that whenever momentary equilibrium is not unique, there is a unique allocation of investment which is consistent with balanced growth. Further, paths which do not tend to balanced growth are shown to be intertemporally inefficient (Shell and Stiglitz (1967, p.592)).

3. Hence, the effect of imposing a subsidy to housing can be investigated by decreasing t_1.

4. A distinction can be made between different classes of private savers (workers and capitalists, for instance), but such a distinction is not very interesting here.

5. The equation of motion for capital of type i is

$$\mathring{k}_i = sf(1-t^*) - g_{j\neq i} - nk_i.$$

Local stability at the point where $\mathring{k}_i = 0$ requires that $\partial\dot{k}_i/\partial k_i < 0$. i.e., $f_i < n/s(1-t^*)$. Multiplying by k_i/f reveals the condition that $\Theta_{K_i} < nk_i/s(1-t^*)f$. But at the point where $\mathring{k}_i = 0$, $s(1-t^*)f = n(k_1+k_2)$. Hence, local stability requires $\Theta_{K_i} < \kappa_i$, which is the inequality (6-1-20).

6. Clearly, more investigation is needed, at both the theoretical, and empirical levels.

7. Of course, this is also true of the static analyses.

8. Auerbach (1979) also considers the optimal taxation of heterogeneous capital. Auerbach's model builds on that developed by Diamond (1965). The economy is characterized by a single production sector, employing two distinct capital goods, and by overlapping generations of individuals who live for two periods.

9. These arguments are analysed in Chapter 1.

10. Arrow and Kurz (1970) employ a similar individual utility function. There, individual utility depends upon per capita consumption, and upon the per capita stock of "social" capital. Manning (1976) also employs a similar utility function. There, social welfare is a quasi-strictly-concave function of per capita consumption, and the level of skill (the ratio of skilled workers to the total population), reflecting the view that education might be desirable in itself.

CHAPTER SEVEN

CONCLUDING COMMENTS

This thesis has presented a theoretical and empirical exploration of the economic implications of housing policies pursued by Western governments. Attention has focused on those policies which provide differential tax treatment for owner-occupied housing relative to rented housing, and to non-residential capital.

The author's original interest in the economic consequences of housing policy was stimulated by the thought that large investments in residential capital have important dynamic implications, which have so far received scant attention. Some of these dynamic implications have been explored in this thesis, but it is clear that there is room for further analysis. The reason the dynamic issues in housing policy have not been more fully explored here is the author's dissatisfaction with the previous treatment of some of the static questions. In particular, the static general equilibrium implications of the preferential tax treatment of owner-occupied housing seemed to warrant considerable theoretical and empirical evaluation.

The three-sector general equilibrium model developed in Chapter 3 of this thesis is not restricted to an analysis of housing policy, of course. It has potential value in the analysis of a large number of other specific tax incentive measures. This is interesting, given the popular political judgement that such measures are a suitable means of achieving economic objectives.

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